SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: (6) National Dam Safety Program

2. GOVT ACCESSION NO.: AD-A092227

3. RECIPIENT'S CATALOG NUMBER:

4. TITLE (and Subtitle): Phase I Inspection Report
Harrower Pond Dam (Inventory Number NY207) (9)
Mohawk River Basin, Montgomery County, New York.
~~Inventory No. 207~~

5. TYPE OF REPORT & PERIOD COVERED: Phase I Inspection Report National Dam Safety Program

6. PERFORMING ORG. REPORT NUMBER:

7. AUTHOR(s): Phase 1 Inspection Report, (10) George/Koch

8. CONTRACT OR GRANT NUMBER(s): (15) DACW 51-79-C-0001

9. PERFORMING ORGANIZATION NAME AND ADDRESS
New York Department of Environmental Conservation
50 Wolf Road
Albany, New York 12233

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS:

11. CONTROLLING OFFICE NAME AND ADDRESS
New York State Department of Environmental Conservation 50 Wolf Road
Albany, NY 12233

12. REPORT DATE: (11) 26 Sept ~~ember~~ 1980

13. NUMBER OF PAGES:

14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)
Department of the Army
26 Federal Plaza New York District, COE
New York, NY 10287

15. SECURITY CLASS. (of this report): UNCLASSIFIED

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE: (12) 91

16. DISTRIBUTION STATEMENT (of this Report)

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18. SUPPLEMENTARY NOTES

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dam Safety
National Dam Safety Program
Visual Inspection
Hydrology, Structural Stability
Harrower Pond Dam
Montgomery County
North Chuctanunda Creek

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report provides information and analysis on the physical condition of the dam as of the report date. Information and analysis are based on visual inspection of the dam by the performing organization.

The examination of documents and the visual inspection of Harrower Pond Dam revealed conditions which constitute an immediate hazard to human life and property. The condition of the dam is considered to be "unsafe, emergency", for the following reasons:

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1. The earth embankment portion of the dam was actively eroding by seepage forces at and above normal pool elevation.

2. The masonry portions of the spillway, spillway buttress, intake chamber, and turbine building are deteriorated and seeping excessively. Portions of the buttress walls are cracked and have moved laterally. Sections of the downstream intake chamber wall and buttress have deteriorated to a point where voids in the walls are present.

3. The structural stability analysis indicates that the spillway portion of the structure is unstable under all loading conditions.

4. The spillway is "seriously inadequate" based on the Corps of Engineers Screening Criteria for initial review of the spillway capacity, and outflows from any storm in excess of 10% of the PMF (Probable Maximum Flood) will overtop the earth embankment portion of the dam. This determination has been confirmed by the overtopping of the dam during the March 15, 1977 storm, which resulted in the need for repairs to the crest and downstream slope in the vicinity of the left spillway buttress.

As a result of the "unsafe, emergency" condition of the dam, a "Summary Abatement Order" was issued by the Commissioner of the New York State Department of Environmental Conservation on May 23, 1980. This order required the immediate removal of wooden stoplogs so that the water level of the reservoir could be drawn down and maintained at a level at least 10 feet below the spillway crest. As of June 23, 1980 the reservoir has been down approximately 6 feet, and the condition of active erosion has been halted. Due to the large drainage area and small storage capacity of the reservoir, an emergency action plan has been developed by Mr. Robert Dolan of the Montgomery County Office of Emergency Preparedness. This plan will be initiated in the event of dam failure.

It is, therefore, recommended that immediately after notification to the owner, detailed engineering investigations be conducted into the aforementioned areas where serious deficiencies have been found. These investigations should include the following:

1. Investigate the conditions of observed seepage and active erosion of the earth embankment.

2. Investigate the conditions of observed deterioration and seepage of the spillway, spillway buttresses, intake chamber, turbine building and tailrace channel.

3. Investigate the structural stability of the spillway, spillway buttresses, concrete spillway apron (particularly where air bubbles emanated), intake chamber, turbine building and earth embankment.

4. Investigate the site specific characteristics of the watershed to more accurately determine the hydrologic/hydraulic capabilities of the dam and watershed.

The investigations must be completed within 8 months of notification, and remedial actions as a result of these investigations completed in the subsequent 12 months.

The additional remedial repairs or actions listed below must be completed within 1 year from notification to the owner.

1. Repair the crest of the earth embankment in an acceptable engineering manner with regard to horizontal and vertical alignment.

2. Monitor at bi-weekly intervals, with the aid of weirs or other measuring devices, the seepage emanating from the base of the right tailrace channel wall, and the soft wet area at the toe of the earth embankment near its midlength, to ascertain if remedial measures are required.

3. Repair the gate systems at the outlet of the intake chamber.

4. Remove the vegetation from the slopes and crest of the embankment and the immediate downstream channel. Provide a program of periodic cutting and mowing of these surfaces.

5. Repair the riprap of the downstream toe of the concrete spillway apron.

6. Provide a program of periodic inspection and maintenance of the dam and appurtenances, including yearly operation and lubrication of the gate systems. Document this information for future reference. Also develop, and periodically update, an emergency action plan.

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
HARROWER POND DAM (I.D. NO. NY 207)
DEC #189A-907 MOHAWK RIVER BASIN
MONTGOMERY COUNTY

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PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Harrower Pond Dam NY 207
State Located:	New York
County:	Montgomery
Watershed:	Mohawk River Basin
Stream:	North Chuctanunda Creek (tributary of Mohawk River)
Dates of Inspection:	May 15, 19, 22, 23 & 28, 1980 June 5 & 23, 1980

ASSESSMENT

The examination of documents and the visual inspection of Harrower Pond Dam revealed conditions which constitute an immediate hazard to human life and property. The condition of the dam is considered to be "unsafe, emergency", for the following reasons:

1. The earth embankment portion of the dam was actively eroding by seepage forces at and above normal pool elevation.

2. The masonry portions of the spillway, spillway buttress, intake chamber, and turbine building are deteriorated and seeping excessively. Portions of the buttress walls are cracked and have moved laterally. Sections of the downstream intake chamber wall and buttress have deteriorated to a point where voids in the walls are present.

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4. The spillway is "seriously inadequate" based on the Corps of Engineers Screening Criteria for initial review of the spillway capacity, and outflows from any storm in excess of 10% of the PMF (Probable Maximum Flood) will overtop the earth embankment portion of the dam. This determination has been confirmed by the overtopping of the dam during the March 15, 1977 storm, which resulted in the need for repairs to the crest and downstream slope in the vicinity of the left spillway buttress.

As a result of the "unsafe, emergency" condition of the dam, a "Summary Abatement Order" was issued by the Commissioner of the New York State Department of Environmental Conservation on May 23, 1980. This order required the immediate

removal of wooden stoplogs so that the water level of the reservoir could be drawn down and maintained at a level at least 10 feet below the spillway crest. As of June 23, 1980 the reservoir has been down approximately 6 feet, and the condition of active erosion has been halted. Due to the large drainage area and small storage capacity of the reservoir, an emergency action plan has been developed by Mr. Robert Dolan of the Montgomery County Office of Emergency Preparedness. This plan will be initiated in the event of dam failure.

It is, therefore, recommended that immediately after notification to the owner, detailed engineering investigations be conducted into the aforementioned areas where serious deficiencies have been found. These investigations should include the following:

1. Investigate the conditions of observed seepage and active erosion of the earth embankment.

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2. Monitor at bi-weekly intervals, with the aid of weirs or other measuring devices, the seepage emanating from the base of the right tailrace channel wall, and the soft wet area at the toe of the earth embankment near its midlength, to ascertain if remedial measures are required.

3. Repair the gate systems at the outlet of the intake chamber.

4. Remove the vegetation from the slopes and crest of the embankment and the immediate downstream channel. Provide a program of periodic cutting and mowing of these surfaces.

5. Repair the riprap of the downstream toe of the concrete spillway apron.

6. Provide a program of periodic inspection and maintenance of the dam and appurtenances, including yearly operation and lubrication of the gate systems. Document this information for future reference. Also develop, and periodically update, an emergency action plan.

George Koch
Chief, Dam Safety Section
New York State Department
of Environmental Conservation
NY License No. 45937

Approved By:

Col. W. M. Smith Jr.
New York District Engineer

Date: 26 SEP 1980

Photo #1
Overview of Harrower Pond Dam
May 23, 1980

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
HARROWER POND DAM I.D. NO. NY 207
DEC #189A-907 MOHAWK RIVER BASIN
MONTGOMERY COUNTY

SECTION 1: PROJECT INFORMATION

1.1 GENERAL

a. Authority

The Phase I Inspection reported herein was authorized by the Department of the Army, New York District, Corps of Engineers, to fulfill the requirements of the National Dam Inspection Act, Public Law 92-367.

b. Purpose of Inspection

Evaluation of the existing conditions of the subject dam to identify deficiencies and hazardous conditions, determine if they constitute hazards to life and property and recommend remedial measures where necessary.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

Harrower Pond Dam consists of a 175' long earth embankment, the maximum height of which is 25 feet above original grade adjacent to the left spillway abutment. A 20 foot high vertical masonry wall forms the spillway section. The spillway is 77 feet long and eight feet in thickness. The area immediately upstream from the spillway is filled in with sediment and the remains of a previously existing timber crib dam. The right spillway abutment is adjacent to an intake and gate/powerhouse which has been abandoned. The powerhouse was used for the mill located to the immediate right (Photo #2).

b. Location

The dam is located on the North Chuctanunda Creek, a tributary of the Mohawk River, approximately 1/2 mile north of the city of Amsterdam, New York.

c. Size

The dam is 25 feet high and impounds approximately 267 acre feet at normal water elevation. The dam, therefore, is classified as "small" in size (25 to 40 feet in height).

d. Hazard Classification

The dam is classified as high hazard due to its location in relation with several homes immediately downstream and the city of Amsterdam within 1/2 mile downstream.

e. Ownership

The dam is owned by G. W. K. Realty Inc., Pioneer St. Amsterdam, NY 12010

f. Purpose of the Dam

Originally the dam was to provide hydropower for the adjacent mill. It

is now used for its aesthetic value and wildlife habitat.

g. Design and Construction History

The only drawing available for the dam was prepared by Charles W. Backer, Engineer, Amsterdam, NY. Dated May 12, 1931, it indicates the existing spillway wall was constructed about 1870 and there was a timber dam that may have been built prior to 1870. No construction records were available.

h. Normal Operating Procedures

Water releases from Harrower Pond are passed over the spillway or through waste gates located in the powerhouse. The intake to the gate is controlled by stop logs.

1.3 PERTINENT DATA

a. Drainage Area (sq. mi.)	35.2
b. Height of Dam (ft.)	25.
c. Discharge at Dam Site (cfs.)	
Spillway (W.S. at top of dam)	2670 cfs.
Waste gates (W.S. at top of dam)	325 cfs.
Maximum Recorded El. 665.7 (Estimated)	3300 cfs.
d. Elevations (ft. USGS.)	
Top of Dam	664.7
Spillway Crest	660.0
Original Streambed	640.
e. Reservoir (acres)	
Surface Area at Top of Dam	40
Surface Area at Spillway Crest	30
f. Storage (acre feet)	
Top of Dam	390
Spillway Crest	267
g. Dam	
Type: Homogenous earth with masonry core wall.	
Length (ft.)	175.
Upstream Slope	1:1
Downstream Slope	1:1
Crest Width (ft.)	12
h. Spillway	
Type: Vertical masonry wall, eight feet in thickness with masonry abutments.	
Length (ft.)	77.
i. Waste Gates	
Type: Located in the powerhouse intake, two 2' x 4' sluice gates, manually controlled.	

SECTION 2: ENGINEERING DATA

2.1 GEOLOGY

The Harrower Pond Dam is located in the northwestern portion of the "Hudson-Mohawk Low Lands" physiographic province of New York State. The province resulted from erosion along outcrop belts of weak rocks between the Adirondack and Catskill Mountains. Generally, the province is of low elevation and relief. Bedrock in the vicinity of the dam is primarily Ordovician (500-435 million years ago) shales and sandstones which have been exposed by the southward and westward stripping off of Silurian and Devonian limestones. The present surficial soil deposits have resulted from glaciations during the Cenozoic Era (most recent 65 million year period), the last of which was the Wisconsin ice sheet, approximately 11,000 years ago.

The "Preliminary Brittle Structures Map of New York" developed by Yngvar W. Isachsen and William G. McKendree (dated 1977), does not indicate the presence of any faulting or other brittle deformations within the vicinity of the dam and impoundment. The map does indicate the demarkation of a major unconformity, less than 1 mile below the dam resulting from orogenic or taphragenic events. This unconformity is the boundary of Middle Ordovician on Lower Ordovician Period.

2.2 Subsurface Investigations

No subsurface investigations could be located for the dam. The "General Soil Map of New York State", prepared by Cornell University Agriculture Experiment Station, indicates that the soils in vicinity of the dam are Mosherville of Glacial till origin. These soils were deposited by wind or water and originated from granite, gneiss, shale and in places sandstone. The soils consist of stony and bouldery silt, some sand and a trace of clay. Generally, the upper soils are moderately permeable. However, the substrate (approx. 1 foot deep) is slowly permeable. Erosion of the surface soil is common due to limited cohesion of the particles. No bedrock was observed in the vicinity of the dam.

2.3 DAM AND APPURTENANT STRUCTURES

The only drawing located for the dam was prepared by Charles W. Backer, Engineer, Amsterdam N.Y. and dated May 12, 1931. This drawing is included in Appendix F. The drawing indicates that the existing limestone masonry spillway wall was built about 1870, and that a wooden dam upstream of this wall was also in place. This wooden structure may have been built prior to the construction of 1870. The drawing also includes information concerning the design of a new concrete spillway which was never built.

The design of the dam includes a limestone masonry spillway and buttresses, an earth embankment at the left abutment with a core wall, and an intake chamber at the right abutment for a now abandoned turbine for the generation of hydro power. The spillway section is founded on a grillage construction system the type of which is not specified. Two gates on the downstream side of the intake chamber serve as reservoir drains.

2.4 CONSTRUCTION RECORDS

No information regarding the construction of the dam is available.

2.5 OPERATION RECORD

No operation record is available.

2.6 EVALUATION OF DATA

The information presented was obtained primarily from NYSDEC files and appears adequate and reliable for Phase I Inspection purposes.

SECTION 3: VISUAL INSPECTION

3.1 FINDINGS

a. General

Visual inspection of Harrower Pond Dam, the surrounding watershed, and the downstream area was conducted on May 15, 1980. Additional inspections concerning the safety and lowering of the water level were conducted on May 19, 22, 23 & 28, June 5 & 23, 1980. During the first inspection, the weather was partly cloudy and the temperature ranged in the upper 50's to low 60's. The reservoir level at the time of the first inspection was El. 660.1 or 0.1 feet above the spillway crest.

b. Spillway

The limestone masonry spillway could not be inspected thoroughly until the inspection of May 28, 1980 due to spillway flow. During this inpsection the entire downstream face from approximately 4 feet below the spillway crest to the toe was wet. In addition one hole was leaking near the left buttress about 2 feet above the toe at a rate of approximately 10 gpm, and the buttress walls were wet and leaking slightly from numerous locations at a rate of about 5 gpm each. Air bubbles were also observed emanating from the concrete spillway apron near the right abutment at several locations. This was probably due to the trapped air and surging water in the adjacent intake chamber due to removal of the stoplogs and subsequent flow. (See Photo #22)

The spillway crest appeared in good condition with no signs of instability. The mortor in the joints of the masonry construction is deteriorated, particularly at the buttresses, and specifically where the left buttress has shifted inward toward the spillway, a distance of approximately 6 inches. This movement was reported to have occurred during a storm in the spring of 1977, at which time overtopping of the adjacent earth embankment occurred and the associated forces caused the movement of the buttress. (See Photos #6, 7, 12, 16 & 17)

The area immediately below the spillway is protected by a concrete spillway apron with riprap at the downstream end. This apron appears to be in good condition (See Photos #20). The area immediately upstream of the spillway is composed of sloping silt and stone up to the crest level. (See Phot #19)

c. Masonry Gate and Intake Structure

The masonry intake structure located at the right abutment is in poor condition. The mortor in the joints is cracked, deteriorated and seeping at numerous locations. The upstream extension of the right spillway buttress which forms the left wall of the intake chamber was wet and seeping, particularly at the base near the water level of the tailrace channel where flow estimated between 100 and 200 gpm was emanating through the joints of the masonry wall. The right wall of the intake chamber was seeping at a rate of 2 to 4 gpm. This wall extends into the brick turbine building. The area where the turbine extends through this wall is seeping. The left and upstream walls of this building are seeping also. The total seepage within the building is estimated to be 15 to 20 gpm. All the masonry and upper brick walls are cracked and deteriorated. It is theorized that the seepage observed on the building walls travels through masonry approach walls and along the backfill before emanating through

the building walls. (See Photos #2, 3 & 4)

The two gates at the outlet of the intake chamber were open. However, these gates were reported very difficult to operate. The downstream masonry wall of the turbine building is badly deteriorated. A 4 feet by 4 feet section of the wall above the gates is completely missing on the outside face, and the inside face appears to be rock and soil rubble. The downstream portion of the right intake chamber wall is also deteriorated, with a 6 feet vertical by 2 feet wide section which is almost completely missing. The upstream and downstream walls of the turbine building were bolted together at 6 locations in the brick portion of the structure. (See Photos #3 & 5)

Considerable seepage was observed emanating from the base of the right foundation wall of the turbine tailrace channel adjacent to a brick building. The flow, while clear, is estimated to be in excess of 30 gallons per minute. (See Photo #3)

d. Earth Embankment

The earth embankment portion, left of the spillway, shows signs of major distress. The crest of the embankment is of variable width and elevation, appearing to broaden and rise as it approaches the left abutment. The slopes of the embankment, while uniform, are heavily vegetated with trees and brush. (See Photos #12 & 19) A soft wet area was observed below the toe of the embankment near its mid point. At the crest adjacent to the left spillway buttress, the owner installed a cement block wall extending out about 8 feet horizontally into the earth embankment and from the crest down to the top of the core wall. This wall was constructed after the 1977 overtopping and subsequent erosion, adjacent to the left spillway buttress, to prevent future problems. (See Photos #2, 8 & 24)

Near the left side of the left spillway buttress, immediately below the area reported to have been overtopped, a timber cribb is present, which is supported by the buttress at one end and a topped tree at the other end. Seepage estimated to be 15 gpm was observed flowing beneath the cribbing toward and over a low masonry wall (entension of left spillway buttress). The flow was clear and no evidence of particle migration was apparent. A void was present immediately below the cribbing where the soil has been eroded or washed away. The surface soil was moist, but no evidence of seepage was apparent beneath the cribbing. An adjacent tree root system was undermined due to the erosion. (See Photos #6, 7, 12, 16 & 17)

The total eroded area had maximum dimensions of 6 to 8 feet in width, and extended from the block wall at the crest to the toe of the embankment. Approximately 6 feet below the block wall, seepage about 3 to 5 gpm was observed em ating from the spillway area through the buttress and issuing into a small void about 4 inches wide 12 inches long and 8 to 12 inches deep. Dye testing was conducted at the spillway crest and it was found that the dye appeared through the buttress in 30 seconds and 1 minute later at the toe of the embankment. The dye appeared to be confined to an area oser to the buttress, indicating that two distinct zones of seepage were present. Additional dye testing, further upstream, showed similar results, with no dye appearing in the left seepage area. Reinspection on May 19, 1980 revealed an increase in the seepage rate at the toe of the earth embankment probably due to the increased spillway flow observed (Approx. 2 inches). The seepage was estimated to be 20 to 25 gpm. In addition, a void

had developed immediately below the block wall on the left side of the spillway buttress, with approximate dimensions of 4 inches wide by 10 inches long and 6 inches deep. Inspection on May 22, 1980 revealed conditions which were nearly identical to that of May 19, 1980 even though the spillway flow had returned to that of May 15 (Approx. 1 inch). (See Photos #6, 7, 8, 9 & 13)

f. May 23, 1980 Inspection

On May 23, 1980 the area was reinspected when it was learned that the stoplogs at the upstream end of the intake chamber were being removed, and it was thought that the water level would be reduced so that inspection of the downstream face of the spillway and the eroded portion of the earth embankment could be conducted. When the inspection team arrived at 3 p.m., 4 stoplogs had been removed and the water was barely cresting the spillway. Examination of the eroded area revealed the formation of a larger void immediately below the block wall, with approximate dimensions of 2 feet in diameter and 3 feet in depth. Seepage at a rate of 5 to 10 gpm was evident in the soft soil at the bottom of the void issuing from the wall of the buttress near the spillway crest level, and is believed to be the cause of the void's enlargement. Mr. Robert Dolan (Montgomery County Office of Emergency Preparedness) detailed the emergency action plan he had developed and which would be initiated in the event of failure. In addition, Mr. Dolan conducted numerous inspections to keep this office abreast of the conditions of the dam. (See Photos #14, 15 & 16)

g. May 28, 1980 Inspection

On May 28, 1980 the area was reinspected and 6 stoplogs had been removed; the reservoir level was about 3 feet below the spillway crest. The seepage rate at the toe of the earth embankment was estimated to be 5 gpm. (See Photo #17)

h. June 5, 1980 Inspection

On June 5, 1980 the dam was reinspected and it was found that 7 stoplogs had been removed, resulting in a reservoir level about 4 feet below the spillway crest. The area at the toe of the earth embankment was wet, but no flow could be discerned. The seepage on the face of the spillway, buttresses, and intake building walls was approximately identical to that of all the previous inspections.

i. June 23, 1980 Inspection

On June 23, 1980 the dam was reinspected and it was found that 10 stoplogs had been removed, resulting in a reservoir level about 6 feet below the spillway crest. The area at the toe of the earth embankment was moist to wet, with no flow observed. The seepage on the downstream face of the spillway extended from about 7 feet below the crest, and the seepage through the right spillway buttress, within the intake chamber was reduced to about 25 gpm. All other conditions remained basically the same.

j. Downstream Area

The downstream channel is littered with large stone rubble and some trees. Some of this stone has been displaced by water action from the toe of the spillway apron. The banks of this channel appear to be stable, but there is an extension growth of trees on the banks reducing the channel capacity. Approximately 9 homes were observed along the right bank of the downstream channel about 500 feet below the dam. (See Photos #10 & 11)

k. Reservoir

There are no visible signs of instability or sedimentation problems in the reservoir area.

3.2 EVALUATION OF OBSERVATIONS

Conditions which constitute a hazard to human life and property were observed during the inspections of this dam. Due to the location of the homes downstream and the severity of conditions observed the dam is assessed as "Unsafe" and is considered to be in an "emergency" category.

The following is a summary of these conditions in order of importance, with the appropriate recommended action:

1. Seepage and ongoing erosion of the downstream slope of the earth embankment portion was occurring prior to lowering of the reservoir level. An engineering investigation is required to determine the type and extent of remedial actions necessary to restore the stability of the structure.

2. The excessive seepage and general deterioration within the walls of the intake chamber and the turbine building require investigation and remedial action.

3. The seepage and deterioration of the spillway and spillway buttresses, including the movement of the buttresses and air bubbles in the concrete spillway apron, require investigation and remedial action.

4. The crest of the earth embankment is not level and of uniform width, the crest has also experienced overtopping. A hydrologic/hydraulic investigation will be required to determine the type and extent of measures necessary to prevent overtopping of the embankment.

5. The seepage in the right wall of the tailrace channel should be monitored at bi-weekly intervals to ascertain if remedial action is required.

6. The gates at the outlet of the intake chamber operate with great difficulty and require repair to insure adequate operation.

7. The soft wet area should be monitored at bi-weekly intervals to ascertain if remedial action is required.

8. The vegetation on the embankment slopes, embankment crest and immediate downstream channel should be cut and a program of periodic cutting and mowing instituted.

9. The displaced riprap in the downstream channel must be relocated at the toe of the spillway apron.

SECTION 4: OPERATION AND MAINTENANCE PROCEDURE

4.1 PROCEDURES

The normal water surface is approximated by the spillway crest, Elevation 660.

4.2 MAINTENANCE OF THE DAM

The dam is maintained by the owner GWK Realty, Inc. Maintenance of the dam is considered unsatisfactory as evidenced by the erosion, seepage and deterioration of the structure, poorly operating gates, poor alignment of the earth embankment crest, vegetation on the embankment, and displaced riprap in the downstream channel.

4.3 WARNING SYSTEM

No warning system was developed by the owner. Mr. Robert Dolan of Montgomery County Emergency Preparedness, has prepared an emergency action plan and warning system. This system and plan will be implemented in the event of dam failure.

4.4 EVALUATION

The dam and appurtenances have not been maintained in satisfactory condition as noted in "Section 3: Visual Inspection".

SECTION 5 HYDRAULIC/HYDROLOGIC

5.1 DRAINAGE AREA CHARACTERISTICS

The Harrower Pond Dam is located on the North Chuctanunda Creek, a tributary of the Mohawk River. The total area of the watershed at Harrower Pond is 35.2 square miles. The total drainage area at its confluence with the Mohawk River is approximately 41 square miles. The 35.2 square miles was delineated into 5 subbasins for the hydrologic analysis. Galway Lake and its watershed comprise the upper 9 square miles. The topography is of generally moderate slope intersperced with swamps and ponds.

5.2 ANALYSIS CRITERIA

The analysis of the spillway capacity of the dam and storage of the reservoir was performed using the Corp of Engineers HEC-1 computer model. The unit hydrograph was defined by the Snyder Synthetic Unit Hydrograph method, and the Modified Puls routing procedure was incorporated. The Probable Maximum Precipitation (PMF) was 19.0 inches (24 hrs., 200 sq. miles) from Hydrometeorological Report #33. in accordance with recommended guidelines of the Corps of Engineers. The floods selected for analysis were 20, 40, 50, 60, 80 and 100% of the Probable Maximum Flood (PMF) flows. The PMF inflow of 25304 cfs was routed through the reservoir and the peak outflow was determined to be 25,276 cfs. The SPF, or 1/2 the PMF inflow and routed outflow was 12517 and 12511 respectively.

5.3 SPILLWAY CAPACITY

The spillway is a 77. feet long masonry wall 20 feet in height and 8 feet in thickness. The structure forms an uncontrolled broad crested weir. The left abutment is 4.7' high, this is the height of flow the spillway could accommodate before overtopping of the earth embankment. The capacity of the spillway at this point is 2670 cfs.

5.4 RESERVOIR CAPACITY

The reservoir capacities at the crest of the spillway, and at the top of the left abutment are 267 and 390 acre-feet respectively. Surcharge storage between the spillway crest and top of dam is equivalent to .07 inches of runoff from the drainage area.

5.5 FLOODS OF RECORD

Maximum known flood was March 15, 1977, flow was overtopping the left abutment by approximately 1 foot, resulting in a partial breach of the earth section of the dam. Estimated flow at that time was 3300 cfs.

5.6 OVERTOPPING POTENTIAL

The maximum capacity of the spillway is 2640 cfs, which is only equivalent to 10% of the PMF. The dam is overtopped by 4.8 feet during 1/2 the PMF and 9.2 feet by the PMF.

5.7 EVALUATION

The spillway of Harrower Pond Dam will safely pass only about 10% of the Probable Maximum Flood. The spillway is therefore assessed as "Seriously Inadequate."

SECTION 6: STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

Signs of major distress were observed in the following areas:

1. The downstream slope of the earth embankment near the left spillway buttress was eroded, and seepage through this buttress was actively eroding the embankment immediately below the core wall.

2. The masonry portions of the spillway, spillway buttresses, intake chamber and turbine building are deteriorated and seeping excessively.

b. Design and Construction Data

No information could be located regarding the structural stability of the structure.

c. Operating Records

No operating records could be located for the structure. The gates of the intake chamber are difficult to operate and require repair.

d. Post Construction Changes

As a result of the overtopping and subsequent erosion of the earth embankment on March 15, 1977 adjacent to the left spillway buttress, a cement block wall was installed on top of the core wall extending about 8 feet horizontally into the embankment. The eroded area was backfilled by the owner.

6.2 STRUCTURAL STABILITY ANALYSIS

A structural stability analysis was conducted for the masonry spillway portion of the dam. The results of the analysis are as follows:

Case	Description of Loading Conditions
1	Normal Operating Conditions, reservoir at El. 660, full uplift no tailwater.
2	Same as Case I, 7.5 kips/L.F. ice load
3	Water at 1/2 PMF level (El. 669.5), uplift as in Case I, tailwater 4.5 feet
4	Water at PMF level (El. 673.9) uplift as in Case I, tailwater = 9 feet
5	Normal Operating Conditions as in Case I, with Seismic Coefficient = 0.1 (Seismic Zone 3)

Case	Factor of Safety Overturning	Location of Resultant from toe	Factor of Safety Sliding
1	0.74	-1.7	0.97
2	0.41	-7.0	0.74
3	0.41	-7.4	0.59
4	0.35	-10.2	0.53
5	0.63	-2.8	0.76

Location of middle 1/3 is 2.67 to 5.33 feet from toe.

Due to the sloping backfill on the upstream face of the spillway the ice loading should approximate that of normal loading conditions. In all cases, however, the factors of safety for the spillway portion analyzed does not meet the factors of safety recommended by the Corps of Engineers for any condition.

Since the structure has withstood normal loading conditions without apparent damage, the analysis (which includes available information) may not indicate the true configuration of the structure and the proper loading conditions. Therefore, it is recommended that an in-depth engineering analysis of the structure be conducted, prior to initiation of any remedial actions.

Further information concerning the stability analysis performed for the purposes of this report is included in Appendix E.

SECTION 7: ASSESSMENT/RECOMMENDATIONS

7.1 ASSESSMENT

a. Safety

The Phase I Inspection of Harrower Pond Dam revealed the following conditions:

1. The earth embankment was actively eroding by seepage forces at and above normal pool level.

2. The masonry portions of the spillway, spillway buttresses, intake chamber, and turbine building are deteriorated and seeping excessively. Portions of the buttress walls are cracked and have moved laterally. Sections of the downstream face of the intake chamber wall and buttress have deteriorated to a point where voids in the wall are present.

3. The structural stability analysis indicates that the spillway portion of the structure is unstable under all loading conditions.

4. The spillway is "seriously inadequate" based on the Corps of Engineers "screening criteria" and outflows from any storm in excess of 10% of the PMF will overtop the earth embankment portion of the dam. This overtopping could cause breaching of the dam and the resulting flood-wave would significantly increase the hazard to downstream residents.

For the aforementioned reasons the dam has been assessed as unsafe, emergency condition.

b. Adequacy of Information

The information reviewed is considered adequate for Phase I Inspection purposes.

c. Need for Additional Investigations

The following investigations are required to be performed by a professional engineer, experienced in dam engineering:

1. Investigate the conditions of observed seepage and active erosion of the earth embankment.

2. Investigate the conditions of observed deterioration and seepage of the spillway, spillway buttresses, intake chamber, turbine building and tailrace channel.

3. Investigate the structural stability of the spillway, spillway buttresses, concrete spillway apron (particularly where air bubbles emanated), intake chamber, turbine building and earth embankment.

4. Investigate the site specific characteristics of the watershed to more accurately determine the hydrologic/hydraulic capabilities of the dam and watershed.

The results of these investigations will determine the type and extent of remedial measures required to restore the stability and safety of the structure.

d. Urgency

A "Summary Abatement Order" was issued by the Commissioner of the New York State Department of Environmental Conservation on May 23, 1980 to Mr. Edward L. Wilkinson and GWK Realty, Inc. the owners of the dam. This order stated that the waters of the reservoir be lowered immediately by at least 10 feet below the crest of the spillway by removal of the wooden stoplogs. Mr. Frank Kraft an adjacent land owner was removing these stoplogs on May 23, 1980 in compliance with this order. As of June 23, 1980 a total of 10 stoplogs have been removed and the reservoir level is approximately 6 feet below the crest of the spillway. The erosive and seepage forces observed from the earth embankment have been reduced to negligable amounts. The seepage forces observed in the left wall of the intake chamber (right spillway buttress) have been reduced considerably, to a seepage rate of approximately 25 gpm. The reservoir level must be lowered 4 feet further and maintained at that level until the investigations and repairs are completed.

The aforementioned actions will reduce the flooding potential, if the dam should fail at this level. In addition, the reduction in seepage forces has in effect halted the active erosion of the earth embankment. However, the size of the drainage area is so great compared to the storage capacity of the reservoir at this lowered level, that computations indicate that a storm having a run-off potential in excess of 0.1 feet in a 24 hour period will fill the reservoir up to and above the spillway crest level, at which point the seepage and erosion of the earth embankment will be initiated.

All significant storms within the drainage area are monitored by Montgomery County Emergency Preparedness (Mr. Robert Dolan). An emergency action plan will be initiated in the event of dam failure.

The aforementioned investigations must be initiated immediately and completed within 8 months from notification to the owner. Remedial measures as a result of these investigations must be completed in the subsequent 12 months.

The remedial repairs or actions listed below must be completed within 1 year from notification to the owner.

7.2 RECOMMENDED MEASURES

1. The results of the aforementioned investigations will determine the appropriate remedial actions required.

2. Repair the crest of the earth embankment in an acceptable engineering manner with regard to horizontal and vertical alignment.

3. Monitor at bi-weekly intervals with the aid of weirs or other measuring devices the seepage, emanating from the base of the right tailrace channel wall and soft wet area at the toe of the earth embankment to ascertain if remedial measures are required.

4. Repair the gate systems at the outlet of the intake chamber.

5. Remove the vegetation on the slopes and crest of the embankment, and the immediate downstream channel. Provide a program of periodic cutting and mowing of these surfaces.

6. Repair the riprap at the downstream toe of the concrete spillway apron.

7. Provide a program of periodic inspection and maintenance of the dam and appurtenances, including yearly operation and lubrication of the gate systems. Document this information for future reference. Also develop, and periodically update, an emergency action plan.

APPENDIX A

PHOTOGRAPHS

Photo #2
Spillway Crest & Right Abutment
5/15/80

Photo #3
Turbine Building @ Right Abutment
Note deteriorated wall
5/15/80

Photo #4
Intake Chamber @ Right Abutment
Note seepage at base of wall
5/19/80

Photo #5
Gate Stems in Turbine Building
5/19/80

Photo #6
Left Spillway Buttress
Note seepage & erosion
5/15/80

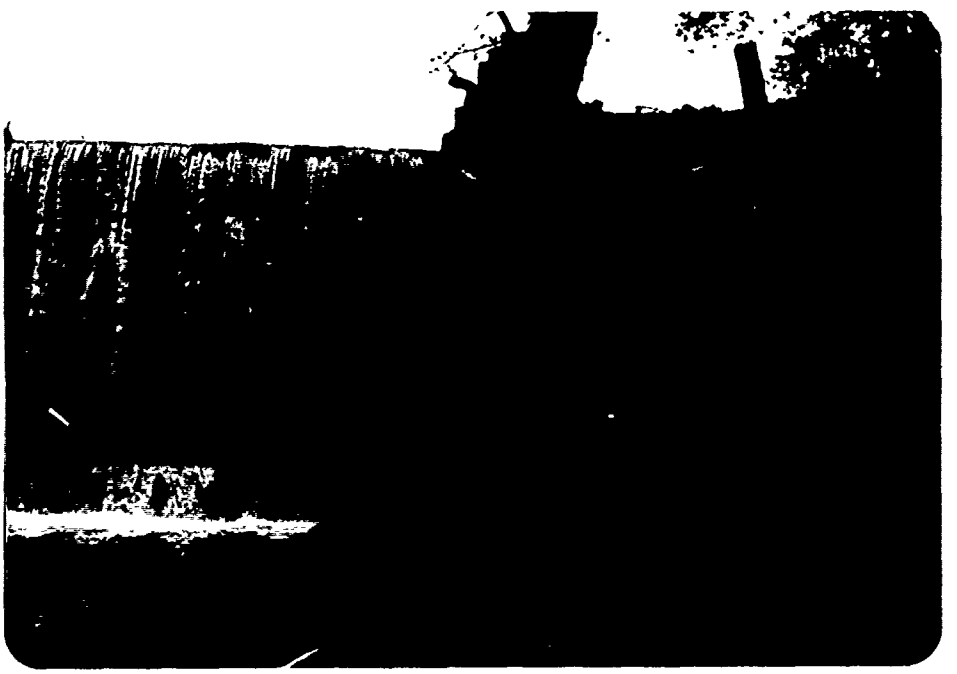


Photo #7
Erosion & Seepage near Buttress
Note bowing of buttress
5/15/80

Photo #8
Erosion of Embankment above Photo #7
Note block core wall
5/15/80

Photo #9
Eroded Area adjacent to Buttress
Seepage emanating from buttress to void area
5/15/80

Photo #10
Immediate Downstream Channel
5/19/80

Photo #11
Downstream Channel
Note low-lying homes
5/15/80

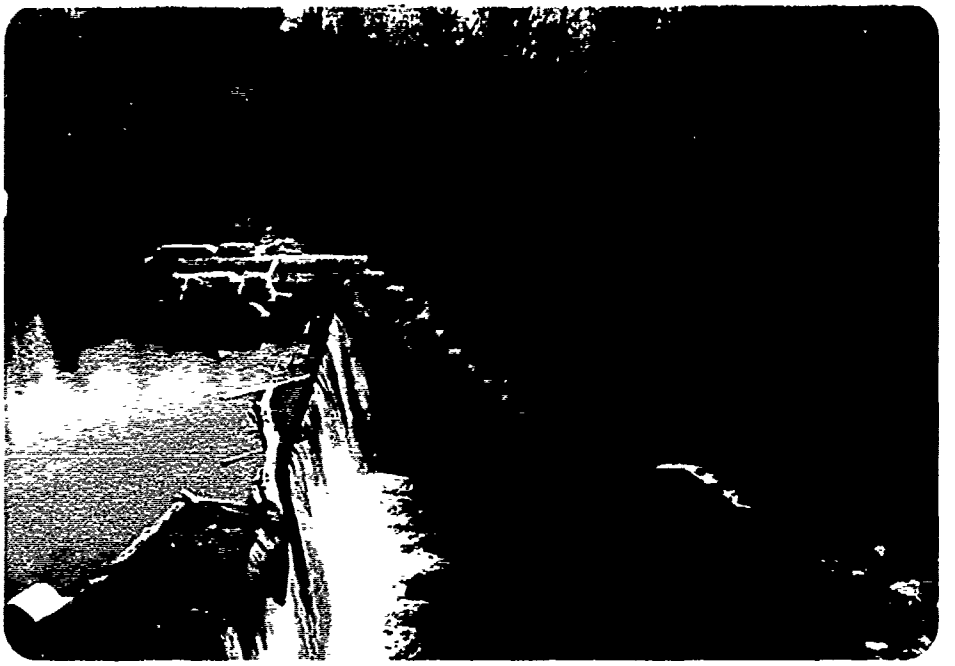


Photo #12
Left Spillway Buttress and Embankment
5/19/80

Photo #13
Eroded Area adjacent to Buttress
Note formation of void at right
5/22/80

Photo #14
Eroded Area Adjacent to Buttress
Note enlargement of void at right
5/23/80

Photo #15
Exploration of Void (Photo #14)
5/23/80

Photo #16
Seepage at Buttress 5/23/80
Compare with Photos #7 & 17

Photo #17
Seepage at Buttress 5/28/80
Compare with Photos #7 & 16

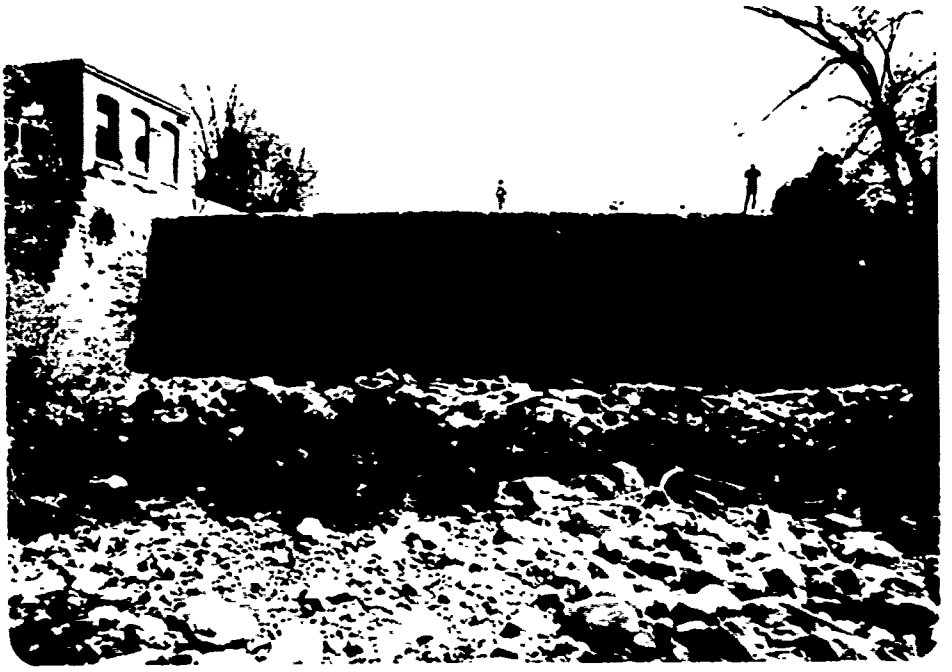


Photo #18
Spillway Downstream Face
Note Seepage (dark area) 5/28/80

Photo #19
Upstream Face
5/28/80

Photo #20
Spillway Downstream Face
Note Seepage (dark areas) 5/28/80

Photo #21
Spillway Seepage near Left Buttress
5/20/80

Photo #22
Air Bubbles near Right Spillway Buttress
5/28/80

Photo #23
Sand Bagging at Left Buttress
(3/77)

Photo #24
Construction of Block Wall Left of Left Buttress (8/30/78)

APPENDIX B

VISUAL INSPECTION CHECKLIST

VISUAL INSPECTION CHECKLIST

1) Basic Data

a. General

Name of Dam Harrower Pond Dam

Fed. I.D. # 207 DEC Dam No. 189A-907

River Basin Mohawk

Location: Town _____ County Montgomery

Stream Name N. Chadwanda Creek

Tributary of Mohawk River

Latitude (N) 42° 57.9' Longitude (W) 74° 10.1'

Type of Dam Earth Embankment Masonry Spillway

Hazard Category "C" - High

Date(s) of Inspection March 10 & 22, 23 & 25, 1980 June 5 & 23, 1980

Weather Conditions Sunny Partly Cloudy 60°F

Reservoir Level at Time of Inspection Approx. 1 inch above spillway 5/5/80

b. Inspection Personnel J.C. Wendel K.D. Hamm J. Kelly R. McCabe DEC

c. Persons Contacted (Including Address & Phone No.)

Mr. Edward Walkowski, 29 E. Main St. Amsterdam, NY 12010

518-842-8422 Mr. Frank Kidd Amsterdam, NY 518

843-1010

d. History:

Date Constructed August 1870 Date(s) Reconstructed [illegible]

1933-34

Designer [illegible]

Constructed By [illegible]

Owner [illegible]

2) Embankment

a. Characteristics

(1) Embankment Material Sand, Silt

(2) Cutoff Type Unknown

(3) Impervious Core Masonry wall, extent unknown

(4) Internal Drainage System None

(5) Miscellaneous Block wall built in 1977-8 adjacent to left spillway bridge, was placed on concrete in eroded area to prevent further erosion

b. Crest

(1) Vertical Alignment Cracks, rises as the right abutment is approached

(2) Horizontal Alignment Cracks, widens as the right abutment is approached

(3) Surface Cracks See above

(4) Miscellaneous Cracks in crest in 1977 were repaired and sealed from left spillway bridge to natural ground crest of the embankment in this area. Considerable Trees & brush

c. Upstream Slope

(1) Slope (Estimate) (V:H) 1:1 near crest changing to 1:2.5

(2) Undesirable Growth or Debris, Animal Burrows

Considerable Trees & brush growth

(3) Sloughing, Subsidence or Depressions 2' diameter depression in vicinity of left spillway bridge which leaves the face a slight bit steeper to avoid the depression, but no visible indication of slides or sloughing

(4) Slope Protection None wave action has undercut slope at waterline

(5) Surface Cracks or Movemen. : Toe not observable

d. Downstream Slope

(1) Slope (Estimate - V:H) 1:1

(2) Undesirable Growth or Debris, Animal Burrows

Conifer trees & brush growth

(3) Sloughing, Subsidence or Depressions depression near left spillway, between 6-8' wide & 6-8' deep from crest to toe of embankment (max dimensions. seepage activity noted at embankment material

(4) Surface Cracks or Movement at Toe none evident

(5) Seepage [illegible] embankment seepage rate clear not [illegible] when observed. [illegible]

(6) External Drainage System (Ditches, Trenches; Blanket) none

[illegible]

(7) Condition Around Outlet Structure [illegible]

(8) Seepage Beyond Toe [illegible]

e. Abutments - Embankment Contact

[illegible]

(1) Erosion at Contact with spillway buttress (see previous comments)
none at left abut

(2) Seepage Along Contact (see previous comments)
none at left abut

3) Drainage System

a. Description of System None

b. Condition of System

c. Discharge from Drainage System

4) Instrumentation (Momumentation/Surveys, Observation Wells, Weirs, Piezometers, Etc.)

None

5) Reservoir

a. Slopes appear stable

b. Sedimentation no problems observed
dam appears to have adequate existing spillway capacity

c. Unusual Conditions Which Affect Dam Large drainage area
small impoundment, has overtopped in 1977

6) Area Downstream of Dam

a. Downstream Hazard (No. of Homes, Highways, etc.) Approx 500 feet below
dam 9 homes on P. [illegible] Road, dam

b. Seepage, Unusual Growth [illegible] 30 gpm flow under
[illegible] to have occurred for many

c. Evidence of Movement Beyond Toe of Dam none

d. Condition of Downstream Channel some debris, stone rubble & trees

7) Spillway(s) (Including Discharge Conveyance Channel)

a. General [illegible]

b. Condition of Service Spillway [illegible]

c. Condition of Auxiliary Spillway None

d. Condition of Discharge Conveyance Channel Concrete apron in good condition. Animal burrows observed 5/22/90 emerging from right side rock buttress at several locations probably due to trapped surface water in rock chambers above.

8) Reservoir Drain/Outlet

Type: Pipe _____ Conduit _____ Other Intake tower/conduit

Material: Concrete _____ Metal _____ Other Masonry

Size: Varies _____ Length _____

Invert Elevations: Entrance _____ Exit _____

Physical Condition (Describe): Unobservable _____

Material: Masonry with steel

Joints: _____ Alignment _____

Structural Integrity: Poor - brick chamber collapsed, bulging, cracks, deterioration & seepage

Hydraulic Capability: _____

Means of Control: Gate Y Valve _____ Uncontrolled _____

Operation: Operable _____ Inoperable _____ Other Submerged

Present Condition (Describe): Not observable

9) Structural

a. Concrete Surfaces [illegible] - mostly cracked [illegible] and generally spalling

b. Structural Cracking [illegible] - particularly [illegible] intake chamber and turbine building [illegible] and seeping - section of right intake wall and downstream wall of turbine building [illegible]

c. Movement - Horizontal & Vertical Alignment (Settlement) [illegible] spillway bulkheads

d. Junctions with Abutments or Embankments
see "embankment section"

e. Drains - Foundation, Joint, Face
none

f. Water Passages, Conduits, Sluices
intake chamber & gate system in poor condition
turbine abandoned

g. Seepage or Leakage [illegible]

h. Joints - Construction, etc. None

i. Foundation [illegible]

j. Abutments [illegible]

k. Control Gates [illegible]

l. Approach & Outlet Channels [illegible]

m. Energy Dissipators (Plunge Pool, etc.) [illegible]

n. Intake Structures [illegible]

o. Stability [illegible]

p. Miscellaneous

10) Appurtenant Structures (Power House, Lock, Gatehouse, Other)

a. Description and Condition

APPENDIX C

HYDROLOGIC / HYDRAULIC

ENGINEERING DATA AND COMPUTATIONS

CHECK LIST FOR DAMS
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

AREA-CAPACITY DATA:

	Elevation (ft.)	Surface Area (acres)	Storage Capacity (acre-ft.)
1) Top of Dam	664.7	70	390
2) Design High Water (Max. Design Pool)	—	—	—
3) Auxiliary Spillway Crest	—	—	—
4) Pool Level with Flashboards	—	—	—
5) Service Spillway Crest	660.0	30	267

DISCHARGES

	Volume (cfs)
1) Average Daily	35 cfs
2) Spillway @ Maximum High Water (Top of Dam)	2670 cfs
3) Spillway @ Design High Water	—
4) Spillway @ Auxiliary Spillway Crest Elevation	—
5) Low Level Outlet	325.
6) Total (of all facilities) @ Maximum High Water	2995.
7) Maximum Known Flood	3300.
8) At Time of Inspection	35 cfs.

CREST: ELEVATION: 667.7

Type: EARTHFILL, PRIMARILY CORE WALL & SPILLWAY

Width: 12' Length: 175'

Spillover

Location SPILLWAY: RIGHT SIDE EMBANKMENT; ADJCT TO POWER.

SPILLWAY:

SERVICE		AUXILIARY
660.0	Elevation	—
PRIMARILY CONCRETE WALL	Type	—
2 FT.	Width	—
	Type of Control	
✓	Uncontrolled	—
	Controlled:	
	Type (Flashboards; gate)	—
	Number	—
	Size/Length	—
	Invert Material	—
	Anticipated Length of operating service	--
	Chute Length	—
	Height Between Spillway Crest & Approach Channel Invert (Weir Flow)	—

HYDROMETEROLOGICAL GAGES:

Type : NONE

Location: -

Records:

Date - -

Max. Reading - -

FLOOD WATER CONTROL SYSTEM:

Warning System: NONE

-

Method of Controlled Releases (mechanisms):

Through waste gates (power house INTAKE).

DRAINAGE AREA: 35.2 SQ MILES.

DRAINAGE BASIN RUNOFF CHARACTERISTICS:

Land Use - Type: RURAL FARMLAND / WOODED 50-50%

Terrain - Relief: MODERATE RELIEF - SIGNIFICANT % STORAGE

Surface - Soil: _____

Runoff Potential (existing or planned extensive alterations to existing (surface or subsurface conditions)

_____

_____

_____

Potential Sedimentation problem areas (natural or man-made; present or future)

_____

_____

_____

Potential Backwater problem areas for levels at maximum storage capacity including surcharge storage:

_____

_____

_____

Dikes - Floodwalls (overflow & non-overflow) - Low reaches along the Reservoir perimeter:

Location: _____

Elevation: _____

Reservoir:

Length @ Maximum Pool _____ (Miles)

Length of Shoreline (@ Spillway Crest) _____ (Miles)

HARROWER Pt.

DRAINAGE AREA: SUBBASIN A & B $= \frac{(62.975 \text{ IN.}^2)\,24000^2}{(144)(43560)(640)} = 9.03 \text{ MI.}^2$

SUB BASIN C $= \frac{(46.12)\,24000^2}{(144)(43560)(640)} = 6.62 \text{ MI.}^2$

SUBBASIN D $= \frac{(30.16)\,24000^2}{(144)(43560)(640)} = 4.33 \text{ MI}^2$

SUBBASIN E $= \frac{(82.06)(24000)^2}{(144)(43560)(640)} = 11.77 \text{ MI.}^2$

SUBBASIN F $= \frac{(24.21)(24000)^2}{(144)(43560)(640)} = 3.48 \text{ MI}^2$

35.23 MI.^{2}

$L_{AB} = \frac{(14.3 \text{ IN.})(24000)}{(12)(5280)} = 5.42 \text{ MI}$ $\quad \Delta EL = 1150 - 857 = 293'$

$L_{CAB} = (3.0') = 1.14 \text{ MI}$ $\quad S = .01$

$L_C = (13.20') = 5.00 \text{ MI}$ $\quad \Delta EL = 960 - 720 = 240'$

$L_{CC} = (7.40) = 2.80 \text{ MI.}$ $\quad S = .01$

HARROWER PH.

$L_D = (9.82'') = 3.72$ mi. $\quad \Delta H = 925 - 725 = 200'$

$L_{DD} = (6.25'') = 2.37$ $\quad S = .01$

$L_E = (19.2'') = 7.27$ $\quad \Delta H = 970 - 720 = 250'$

$L_{CE} = (11.8'') = 4.47$ $\quad S = .007$

$L_F = (9.2'') = 3.49$ $\quad \Delta H = 75 - 660 = 90'$

$L_{CF} = (4.5'') = 1.70$ $\quad S = .005$

AREA	$(Mi)^2$	C_t	t_p	t_r	SAY	$T_p = t_p + .st_r$	C_p
AB	9.03	2.0	3.45	0.63	0.60	3.75	0.625
C	6.62	2.0	4.41	0.80	0.80	4.81	0.625
D	4.33	2.0	3.84	0.70	0.70	4.19	0.625
E	11.77	2.4	6.82	1.24	1.25	7.45	0.625
F	3.48	~~2.8~~ 2.0	~~4.78~~ 3.42	0.62	0.50	3.67	0.625

MR. STATION PMP (in.) from HYDROMET '33 = 19 in.

DURATION	6	12	24	48
%	96	109	119	127

```
*********************************************                    **********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)                                 NEW YORK STATE
DAM SAFETY VERSION      JULY 1978                                DEPT OF ENVIRONMENTAL CONSERVATION
  LAST MODIFICATION  26 FEB 79                                   FLOOD PROTECTION BUREAU
  MODIFIED FOR HONEYWELL APR 79
*********************************                                **********************************
    1                A     HARRCWER POND DAM
    2                A     NY 207  MOHAWK
    3                A     10 JUNE 1980
    4                B     200       0       30        0        0        0        0        0        0        0
    5                B1      5
    6                J       1        6        1
    7                J1    .2       .4       .5       .6       .8        1
    8                K       0        1                                  1
    9                K1    HYDROGRAPH  SUBAREA  AB
   10                M       1        1     9.03             35.2                                    1
   11                P                19       96      109      119      127
   12                T                                                          1.0      0.1
   13                W     0.75     .625
   14                X      -2        2        1
   15                K       1        1                                  1
   16                K1    ROUTE RUNOFF FROM AB THROUGH GALWAY LAKE       1
   17                Y                                1        1
   18                Y1      1                                          .855       -1
   19                Y4    845      851      860      863      865      867      869
   20                Y5      5      118      145     1753     2400     4213     6617
   21                $S    100      900     2810     4936     7706     9605
   22                $$    835      845    850.5      855      960      863
   23                $$    840
   24                SO    703      2.9      1.5      400
   25                K       1        2                                  1
   26                K1    CHANNEL ROUTE TO CO
   27                Y                                1        1
   28                Y1      8
   29                Y6   .045     .045     .045      750      840    20400    .0054
   30                Y7              840      500      800     2110      754     2111      750     2131      750
                     ..    ...      ...     2760      830     3500      840
```

```
K              2                                                    1
K1   HYDROGRAPH SUBAREA C
M     1        1    6,62              35,2                                    1
P              19       96      109      119      127
T                                                                   1       ,1
W    4,81     ,625
X    -2,0      2        1
K     2        2                                                    1
K1   COMBINE AB AND C @ CD
K              2                                                    1
K1   HYDROGRAPH SUBAREA D
M     1        1    4,33              35,2                                    1
P              19       96      109      119      127
T                                                                   1       ,1
W    4,19     ,625
X     -2       2        1
K     2        2                                                    1
K1   COMBINE AB, C, AND D @ CD
K              2                                                    1
K1   HYDROGRAPH SUBAREA E
M     1        1   11,77              35,2                                    1
P              19       96      109      119      127
T                                                                   1       ,1
W    7,45     ,625
X    -2.       2,       1
K     2        2                                                    1
K1   COMBINE AB, C , D, AND E @ CD
K     1        3                                                    1
K1   CHANNEL ROUTE TO HARRCHER POND DAM
Y                                    1        1
Y1    P
Y6   ,045     ,045     ,045      660      750    17200     ,006
```

```
K                2                                                  1
K1   HYDROGRAPH SUBAREA C
H       1        1     6.62              35.2                                        1
P                19       96      109      119      127
T                                                                   1       .1
W    4.81     .625
X    -2.0        2        1
K       2        2                                                  1
K1   COMBINE AB AND C @ CD
K                2                                                  1
K1   HYDROGRAPH SUBAREA D
H       1        1     4.33              35.2                                        1
P                19       96      109      119      127
T                                                                   1       .1
W    4.19     .625
X     -2        2        1
K       2        2                                                  1
K1   COMBINE AB, C, AND D @ CD
K                2                                                  1
K1   HYDROGRAPH SUBAREA E
H       1        1    11.77              35.2                                        1
P                19       96      109      119      127
T                                                                   1       .1
W    7.45     .625
X    -2.      2.       1
K       2        2                                                  1
K1   COMBINE AB, C , D, AND E @ CD
K       1        3                                                  1
K1   CHANNEL ROUTE TO HARRIMER POND DAM
Y                                    1        1
Y1      0
YR   .045     .045     .045      660      750    17200     .006
```

```
Y7  1010     666     1400     680     2200     750
K                3                                        1
K1  HYDROGRAPH SLBAREA F
N       1        1    3.48             35.2                                    1
P               19      96      109      119      127
T                                                         1       .1
W   3.67     .625
X     -2        2        1
K      2        3                                         1
K1  COMBINE AB, C, D, E, AND F @ HARROWERS POND DAM
K      1        3                                         1
K1  ROUTE TOTAL FLOW THROUGH RESERVOIR                    1
Y                                       1        1
Y1     1                                                          -660       -1
Y4   660      661      662      663      664      666
Y5              230      700     1360     2095     3850
S5     12       53      135      267
SE    645      650      655      660
S3    660
SC  654.7        3      1.5      175
K      95
A
A
A
A
A
```

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	1
ROUTE HYDROGRAPH TO	1
ROUTE HYDROGRAPH TO	2
RUNOFF HYDROGRAPH AT	2
COMBINE 2 HYDROGRAPHS AT	2
RUNOFF HYDROGRAPH AT	2
COMBINE 2 HYDROGRAPHS AT	2
RUNOFF HYDROGRAPH AT	2
COMBINE 2 HYDROGRAPHS AT	2
ROUTE HYDROGRAPH TO	3
RUNOFF HYDROGRAPH AT	3
COMBINE 2 HYDROGRAPHS AT	3
ROUTE HYDROGRAPH TO	3
END OF NETWORK	

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 0.20	RATIO 2 0.40	RATIO 3 0.50	RATIO 4 0.60	RATIO 5 0.80	RATIO 6 1.00
HYDROGRAPH AT	1	9.03	1	2429.	4858.	6072.	7286.	9715.	12144.
		(6546 3.80)		(68.76)(	137.55)(	171.94)(	206.33)(	275.10)(	343.88)(
ROUTED TO	1	9.03	1	135.	144.	509.	952.	1843.	3866.
		(6546 3.80)		(3.83)(	4.08)(	14.40)(	26.95)(	52.18)(	109.47)(
ROUTED TO	2	9.03	1	140.	144.	508.	951.	1840.	3850.
		(6546 3.80)		(3.97)(	4.08)(	14.39)(	26.92)(	52.09)(	109.03)(
HYDROGRAPH AT	2	6.62	1	1489.	2977.	3721.	4466.	5954.	7443.
		(654 3.80)		(42.15)(	84.30)(	105.38)(	126.45)(	168.61)(	210.76)(
2 COMBINED	2	15.65	1	1620.	3112.	3859.	4605.	6129.	8128.
		6546 3.80)		(45.87)(	88.14)(	109.27)(	130.40)(	173.53)(	230.17)(
HYDROGRAPH AT	2	8.33	1	1076.	2153.	2691.	3229.	4306.	5382.
		(6546 3.80)		(30.48)(	60.95)(	76.20)(	91.44)(	121.93)(	152.41)(
[illegible]	2	19.96	1	2693.	5259.	6542.	7825.	10364.	13077.
		(6546 3.80)		(76.27)(	148.92)(	185.25)(	221.57)(	294.32)(	370.29)(
[illegible]	2	11.77	1	1890.	3779.	4724.	5669.	7558.	9448.
		(6546 3.80)		(53.51)(	107.01)(	133.76)(	160.52)(	214.02)(	267.53)(
	2	[illegible]	1	4322.	8617.	10615.	12712.	16949.	21745.
		[illegible]		(122.40)(	241.18)(	300.58)(	359.97)(	479.93)(	615.75)(
[illegible]	3	31.75	1	4317.	8511.	10609.	12704.	16940.	21741.
		(8 [illegible] 3.80)		(122.25)(	241.01)(	300.40)(	359.74)(	479.70)(	615.64)(
[illegible]	3	3.48	1	945.	1891.	2363.	2835.	3780.	4725.
		(654 [illegible] 3.80)		(26.76)(	53.52)(	66.90)(	80.28)(	107.04)(	133.81)(
[illegible]	3	35.23	1	5072.	[illegible]	12517.	14997.	19960.	25304.
		(654 [illegible] 3.80)		(143.62)(	284.38)(	354.44)(	424.68)(	565.22)(	716.54)(
[illegible]	3	35.21	1	5076.	10036.	12511.	14989.	19973.	25276.
		(654 [illegible] 3.80)		(143.72)(	284.19)(	354.27)(	424.43)(	565.57)(	715.73)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN : .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	855.00	840.00	863.00
STORAGE	4936.	233.	9605.
OUTFLOW	130.	85.	1753.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.20	856.80	0.	5933.	135.	0.	54.50	0.
0.40	859.65	0.	7515.	144.	0.	57.00	0.
0.50	860.66	0.	8135.	509.	0.	53.00	0.
0.60	861.50	0.	8659.	952.	0.	51.50	0.
0.80	863.12	0.12	9683.	1843.	4.00	50.50	0.
1.00	864.29	1.29	10420.	3866.	11.00	48.50	0.

PLAN 1 STATION 2

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.20	140.	751.1	2.00
0.40	144.	751.2	58.00
0.50	508.	754.1	54.50
0.60	951.	755.1	52.50
0.80	1840.	756.0	51.50
1.00	3850.	758.0	49.50

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.20	4317.	667.8	45.00
0.40	8511.	670.5	45.00
0.50	10609.	671.4	45.00
0.60	12704.	672.2	45.00
0.80	16940.	673.9	45.50
1.00	21741.	675.0	45.50

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	660.00	660.00	664.70
STORAGE	267.	267.	391.
OUTFLOW	0.	0.	2709.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.20	666.25	1.55	432.	5075.	8.50	45.00	0.
0.40	668.54	3.84	493.	10036.	14.00	45.00	0.
0.50	669.53	4.83	513.	12511.	17.00	45.00	0.
0.70	670.45	5.75	543.	14989.	19.50	45.00	0.
0.80	672.17	7.47	588.	19973.	23.50	45.00	0.
1.00	673.65	9.15	633.	25276.	25.50	45.00	0.

APPENDIX D

REFERENCES

APPENDIX D

REFERENCES

1) U.S. Department of Commerce, Technical Paper No. 40, Rainfall Frequency Atlas of the United States, May 1961.

2) Soil Conservation Service, National Engineering Handbook, Section 4, Hydrology, August 1972 (U.S. Department of Agriculture).

3) H.W. King and E.F. Brater, Handbook of Hydraulics, 5th edition, McGraw-Hill, 1963.

4) T.W. Lambe and R.V. Whitman, Soil Mechanics, John Wiley and Sons, 1965.

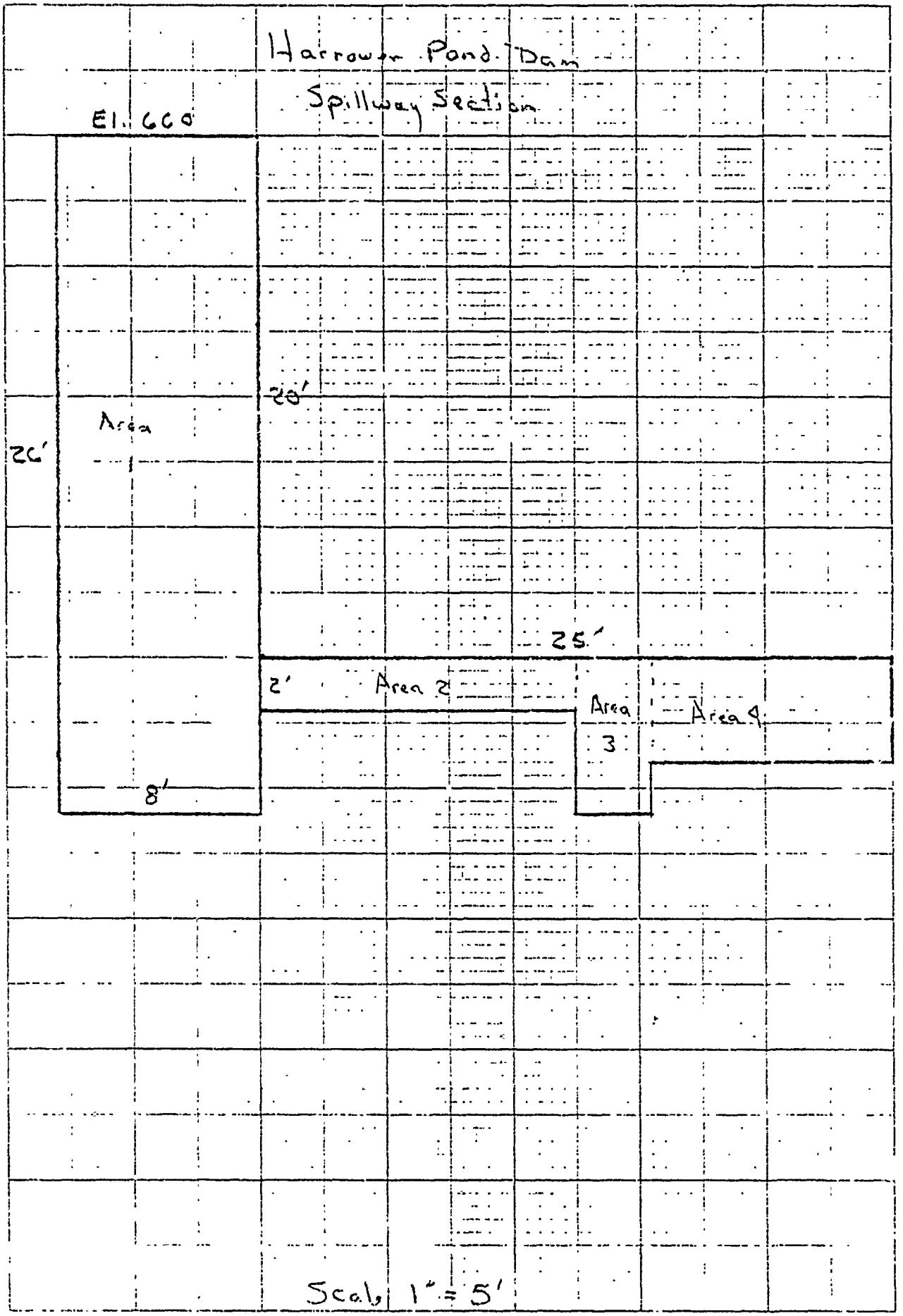
5) W.D. Thornbury, Principles of Geomorphology, John Wiley and Sons, 1969.

6) University of the State of New York, Geology of New York, Education Leaflet 20, Reprinted 1973.

7) Cornell University Agriculture Experiment Station (compiled by M.G. Cline and R.L. Marshall), General Soil Map of New York State and Soils of New York Landscapes, Information Bulletin 119, 1977.

APPENDIX E

STABILITY ANALYSIS


Harrower Pond Dam
Spillway Section
El. 660
20'
Area
26'
25'
2'
Area 2
Area
3
Area 4
8'
Scale 1" = 5'

INPUT FOR STABILITY ANALYSIS PROGRAM

Input Location	Input Parameter Description
0	Unit Weight of Dam ($K/ft.^3$)
1	Area of Segment #1 ($ft.^2$)
2	Location of Center of Gravity from toe (ft.) Segment #1
3	Area of Segment #2 ($ft.^2$)
4	Location of CG from toe, Seg. #2 (ft.)
5	Area of Segment #3 ($ft.^2$)
6	Location of CG from toe, Sg. #3 (ft.)
7	Total Base Width of Dam (ft.)
8	Height of Dam (ft.)
9	Ice Loading (K/L.F.)
10	Coefficient of Sliding
11	Unit Weight of Soil ($K/ft.^3$)
12	Coefficient of Active Soil Pressure - Ka
13	Coefficient of Passive Soil Pressure - Kp
14	Height of Water over Top of Dam (ft.)
15	Height of Soil for Active Pressure (ft.)
16	Height of Soil for Passive Pressure (ft.)
17	Height of Water in Tailrace Channel (ft.)
18	Unit Weight of Water ($K/ft.^3$)
19	Area of Segment #4 ($ft.^2$)
20	Location of CG from toe, Seg. #4 (ft.)
46	Height of Ice Load or Active Water
49	Location of Foundation Drains from Heel (ft.)
50	Seismic Coefficient (α)

Stability Analysis
Input Parameters

Input Location	Case I	Case II	Case III	Case IV	Case V
00	.15				
01	208				
02	4				
03	25				
04	5				
05	18				
06	3				
07	8				
08	26				
09	0	7.5	0	0	0
10	55				
11	.06				
12	.15				
13	3.0				
14	0	0	9.5	13.9	0
15	26				
16	6				
17	0	0	4.5	9.0	0
18	.0624				
19	38				
20	4				
46	26				
50	0	0	0	0	.1

HARROWER POND DAM
STABILITY ANALYSIS
SPILLWAY SECTION

Case I Normal Loading

(a) .7422294204

(b) -1.704691213

(c) .9743100791

Case II Ice Loading

(a) .4123614066

(b) -6.994921379

(c) .7433082963

Case III 1/2 PMF

(a) 0.406769483

(b) -7.422223901

(c) .5949340009

Case IV PMF

(a) .3472156529

(b) -10.23898076

(c) .5313298444

Case V Seismic Loading

(a) .6336509772

(b) -2.837890636

(c) .7632388055

NOTE: (a) is the factor of safety for overturning;

(b) is the location of the resultant from the toe;

(c) is the factor of safety for sliding.

APPENDIX F

DRAWINGS

15 (12/75)

New York State Department of Environmental Conservation

MEMORANDUM

TO: George Koch
FROM: Robert McCarty
SUBJECT: Harrower Pond Dam

DATE: May 21, 1980

At 11:50 a.m., this date, we received a telegram from Mr. Thomas F. Costanzo confirming our opinion of the unsafe emergency condition (red cover) at the Harrower Pond Dam. This determination was made after inspections by Messers J. Kelley, K. Harmer, J. Veitch and R. McCarty of the Dam Safety Section on May 15, 1980. The water level was approximately 1 inch above the spillway crest. The dam is considered unsafe because of the erosion and seepage (approximately 10 to 15 gpm) observed on the downstream slope of the earth embankment adjacent to the left spillway buttress, and the extensive seepage (approximately 200 gpm) through the right masonry spillway buttress. Erosion of the earth embankment is approximately 6 to 8 feet wide with a maximum depth of 6 to 8 feet. The erosion extended from the crest of the dam to the toe. Dye testing of the spillway area indicated that a portion of the seepage was traveling through the spillway buttress and emerging at the toe of the dam.

The Corps of Engineers was contacted on May 16, 1980 after an unsuccessful attempt late in the day of the inspection. Mr. Anthony Barbero of the Foundations and Materials Section of the Corps agreed to inspect the dam on May 19, 1980. The dam was inspected on May 19, 1980 with the following in attendance: Messers A. Barbero, G. Koch, K. Harmer, and R. McCarty. The water level was approximately 2 inches above the crest of the spillway. The seepage rate at the toe of the eroded embankment section was estimated to be 20 to 25 gpm, though no particle migration was observed at either inspections.

The Corps of Engineers confirmed our opinion of the unsafe emergency condition and Mr. Costanzo was informed. Mr. Koch telephoned the owners representatives (Mr. Edward Wilkinson) on May 19, 1980 to notify them of the condition. The telegram was sent to Mr. Wilkinson on May 21, 1980.

Today Messers. Arnold Gruskey, Robert Dolan and Edward Touchette of NYS Disaster Preparedness and Mr. Marty Skotarczak Montgomery County E.C.O. were informed of the status of the dam. A telicopy of the telegram was forwarded to Mr. Grusky. Mr. Dolan (Montgomery Co. D.P.) and Mr. Skotarczak will inspect the site on May 22, 1980 and keep us informed of the situation.

RM/ps

15 (12/75)

New York State Department of Environmental Conservation

MEMORANDUM

TO: George Koch
FROM: Robert McCarty
SUBJECT: Harrower Pond Dam 189-907 Mohawk River Basin

DATE: May 28, 1980

The following events have occurred relating to the subject dam since my last formal correspondence to you, dated May 21, 1980.

May 21, 1980

Mr. Robert Dolan (Montgomery Co. D.P.), Mr. Martin Skotarczak (Region 4 ECO), and a representative of the Montgomery County Sheriff met at the site to investigate the unsafe conditions at the dam. Mr. Edward Wilkinson was contacted and requested to meet at the site. Mr. Wilkinson refused to meet with them stating that he was unwilling and unable to attend. The unsafe conditions previously described (Memo-May 21, 1980) were verified by those in attendance.

May 22, 1980

Mr. Wilkinson's refusal to assist us in lowering the reservoir, the difficulties in locating the actual owner of the dam, and the urgency involved with the unsafe emergency conditions, initiated the process for the development of the Commissioner's Summary Abatement Powers with regards to lowering the reservoir level.

I made an inspection of the dam at about 4 p.m. and found the seepage and erosion conditions approximately identical to that observed with you on May 19, 1980. The only significant difference appeared to be the return of the spillway flow back to that observed during our original inspection of May 15, 1980 (approximately 1 inch of flow over the spillway.)

At 3 p.m. Mr. Dolan met with the Mayor of Amsterdam, the City Police Chief and the City Engineer (James Oakel.) The emergency unsafe conditions were described to those in attendance. Mr. Dolan was also preparing an emergency action plan for notification of downstream residents and the proper governmental authorities at this time.

May 23, 1980

The Summary Abatement Order was delivered to Mr. Wilkinson and an attempt was made to serve KWG Realty in Newburgh. Apparently no KWG Realty exists in Newburgh and the Order was not served. It appears that GWK Realty on Pioneer Street in the Town of Amsterdam is the correct owner as I informed you on May 14, 1980. The Order will hopefully be served to them on May 28, 1980.

Mr. Dolan inspected the dam about noon this date and found Mr. Frank Kraft, an adjacent land owner, cutting brush at the right abutment. Mr. Kraft stated that he was taking it upon himself, with the aid of Dr. Blanchard's children, to remove the stoplogs to comply with our orders.

Messers K. Harmer, J. Veitch and R. McCarty of this office conducted another site inspection at 3 p.m. after learning of the intended stoplog removal. At the site it was found that 4 stoplogs had been removed and the water surface of the reservoir was dropping so that the water was barely cresting the spillway. Observation of the eroded area at the left abutment of the spillway revealed that the small eroded area which had developed by May 19, 1980, and appeared approximately the same size on May 22, 1980, had widened and deepened forming a hole approximately 2 feet in diameter and 3 feet deep. This hole is located directly downstream of the core wall. Seepage at a rate of 5 to 10 gpm was eminating from the spillway buttress, and is believed to be the side cause of the erosion.

In addition to the aforementioned Dam Safety Section personnell, Mr. Robert Dolan, Mr. James Oakel and Mr. Frank Kraft, observed the new erosion condition at the left spillway abutment. Mr. Kraft stated that he and his associates would remove additional stoplogs at about 6 p.m. that night. Mr. Dolan stated that he would make periodic inspections of the dam over the holiday weekend and report to us if necessary. In addition he showed us the emergency action plan he had developed and will implement if necessary.

May 27, 1980

Mr. Dolan telephoned us about 10 a.m. to inform us that the reservoir level was down approximately 3 feet below the spillway crest and that the seepage at the toe of the left spillway buttress had decreased significantly due to the drop in level and shutoff of flow through the buttress at the spillway crest. No additional stoplogs had been removed since 1:30 p.m. May 23, 1980.

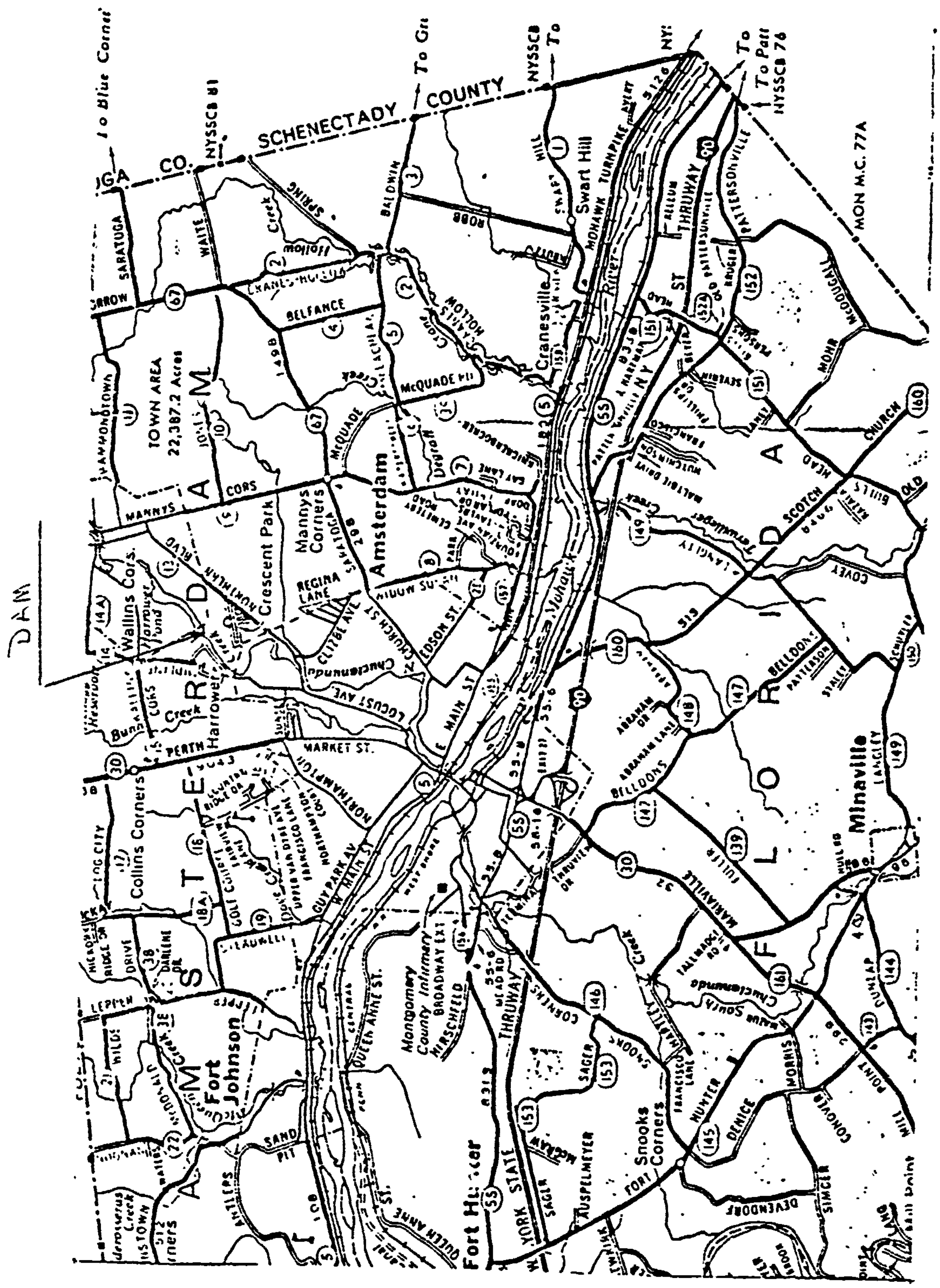
I telephoned Mr. Kraft to find out when additional stoplogs would be removed. He stated that he had insufficient help to remove more logs, but that a crew would be assembled that night.

May 28, 1980

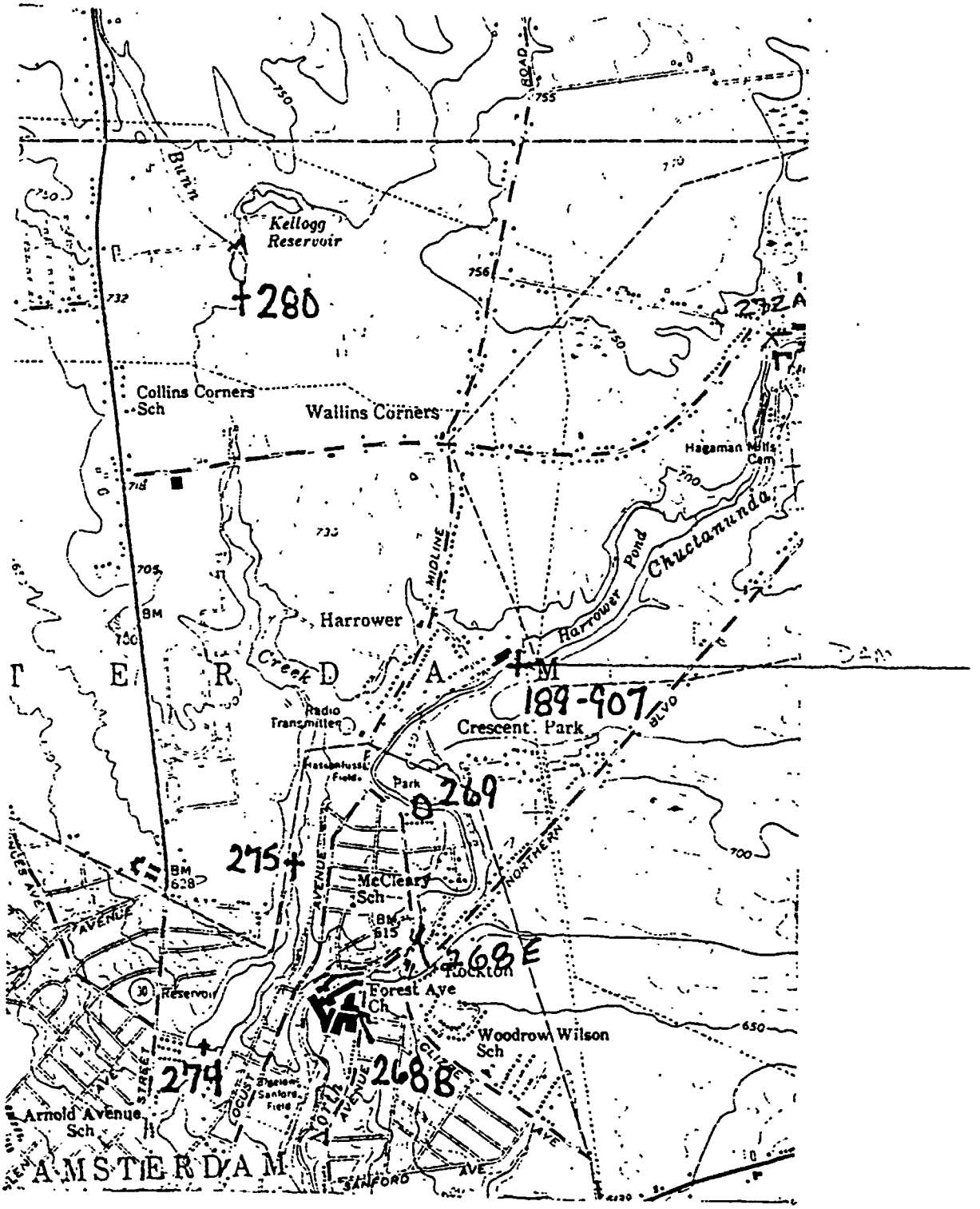
Mr. Dolan met with Messers. K. Harmer, J. Veitch and R. McCarty at the site at 10:30 a.m. We observed the conditions described by Mr. Dolan the previous day and 3 men were removing a stoplog. An additional log was removed the previous night. This brings the total removal to 6 stoplogs. Mr. Edward Sinden met us at the site at about 11:30 a.m. and stated that the removal of logs would continue as the water pressure permitted. The seepage rate at the toe of the buttress is estimated to be less than 5 gpm. Since the spillway was not flowing the downstream surface could be inspected carefully. The entire downstream face approximately 4 feet below the crest to the toe of the spillway was wet. In addition one hole was leaking near the left spillway buttress about 2 feet above the toe at a rate of 10 gpm and the buttress walls were wet and leaking slightly from numerous locations at a total rate of about 5 gpm. Air bubbles were also observed eminating from the concrete spillway apron near the right abutment at several locations. This is probably due to the trapped air and surging water in the intake chamber below where the stoplogs are being removed.

Mr. Dolan stated that a room had been reserved on June 5, 1980 at 10 a.m. in the County Office Building in Fonda, N.Y. for the proposed hearing. He also asked if a notice of this hearing should be advertised in the local papers. I would think that this is a proper course of action. Mr. Edward Sinden was informed of the hearing and either he or Mr. Kraft will attend. Representatives of the Blanchard family will probably be there also.

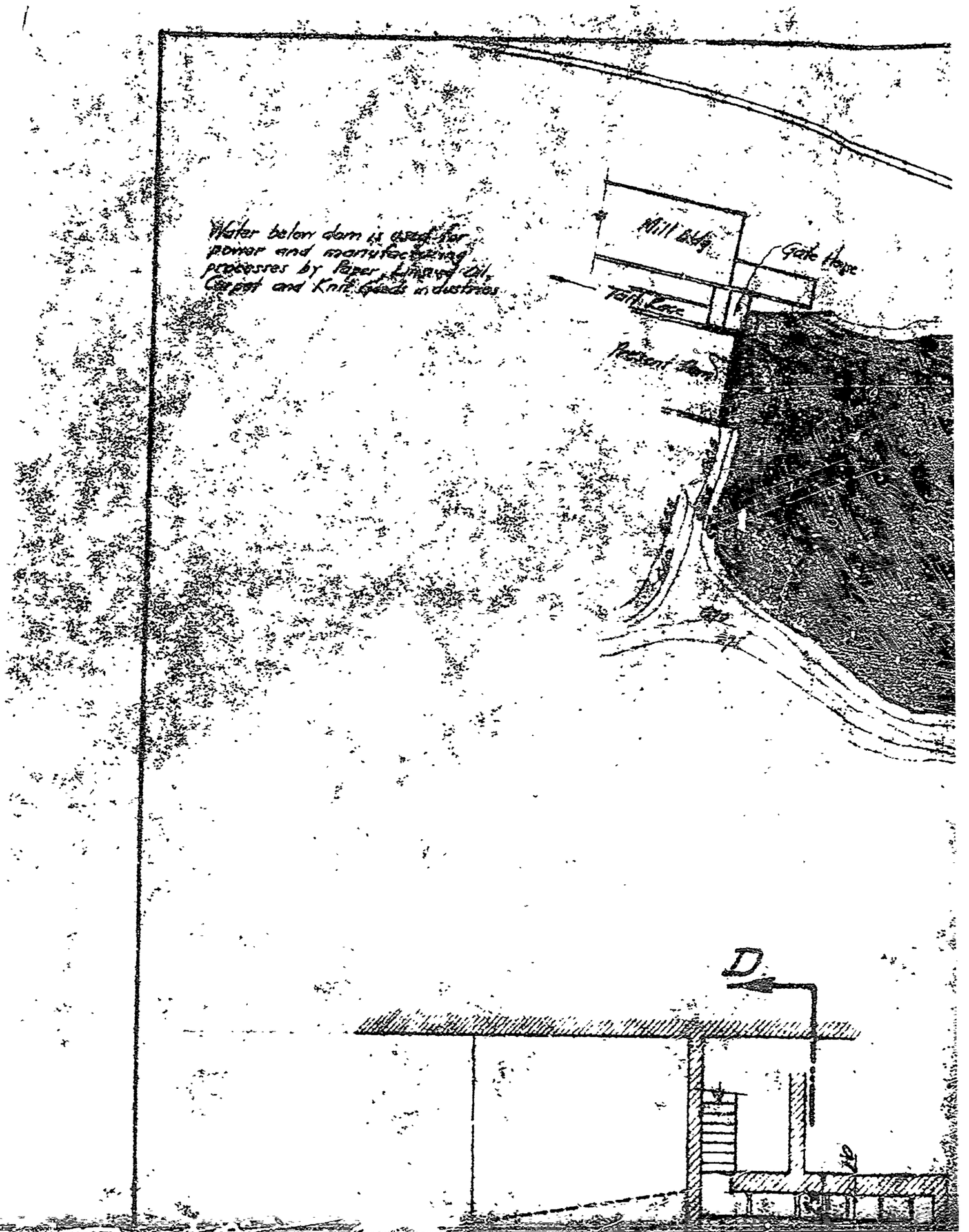
RM/ps



VICINITY MAP



TOPOGRAPHIC MAP

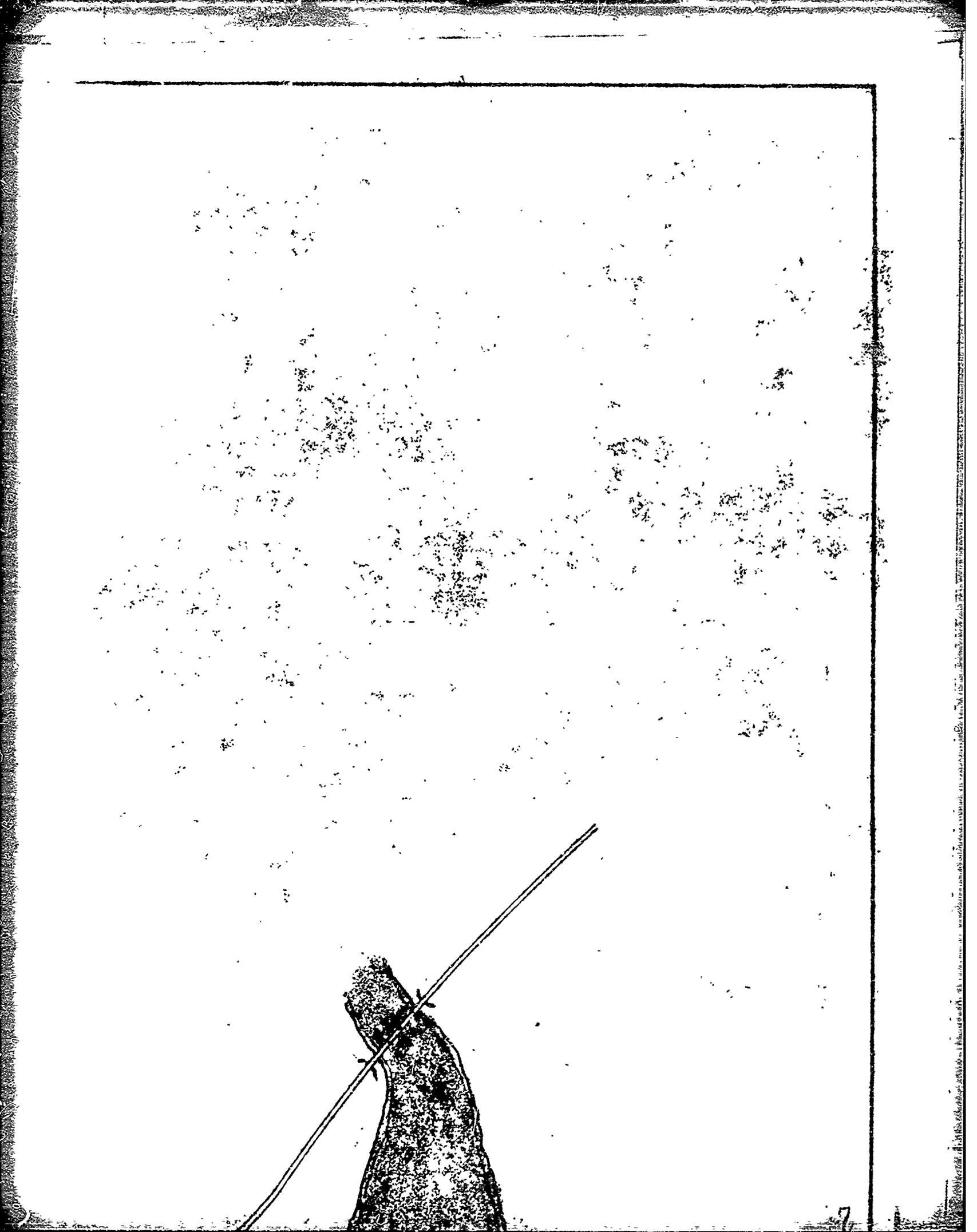

Water below dam is used for power and manufacturing processes by Paper, Linoleum Oil, Carpet and Knit Goods industries
Mill Bldg
Gate House
Tail Race
Present Dam
D

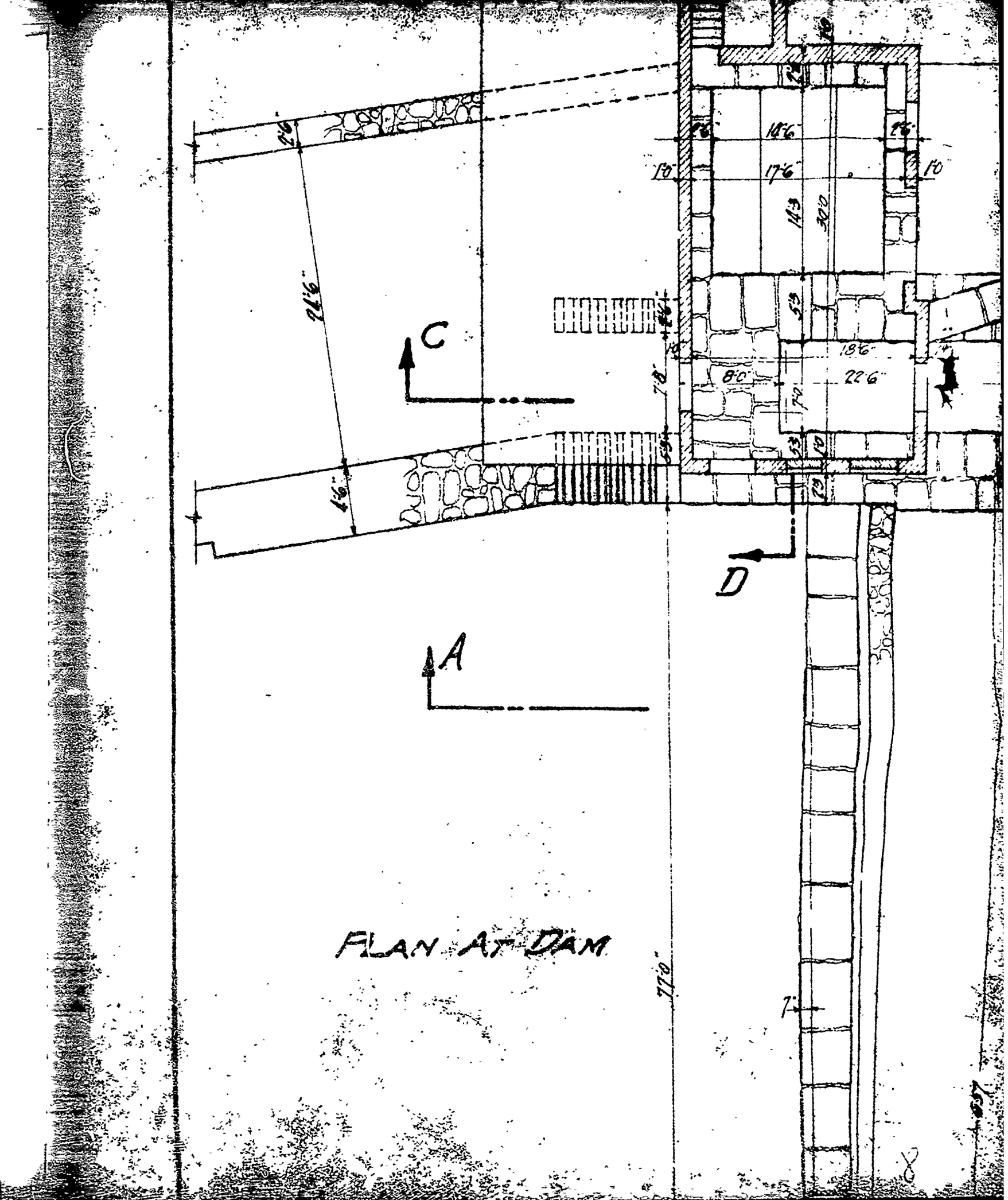

F.J. & G. Railroad Trolley Line

TOPOGRAPHY AT POND

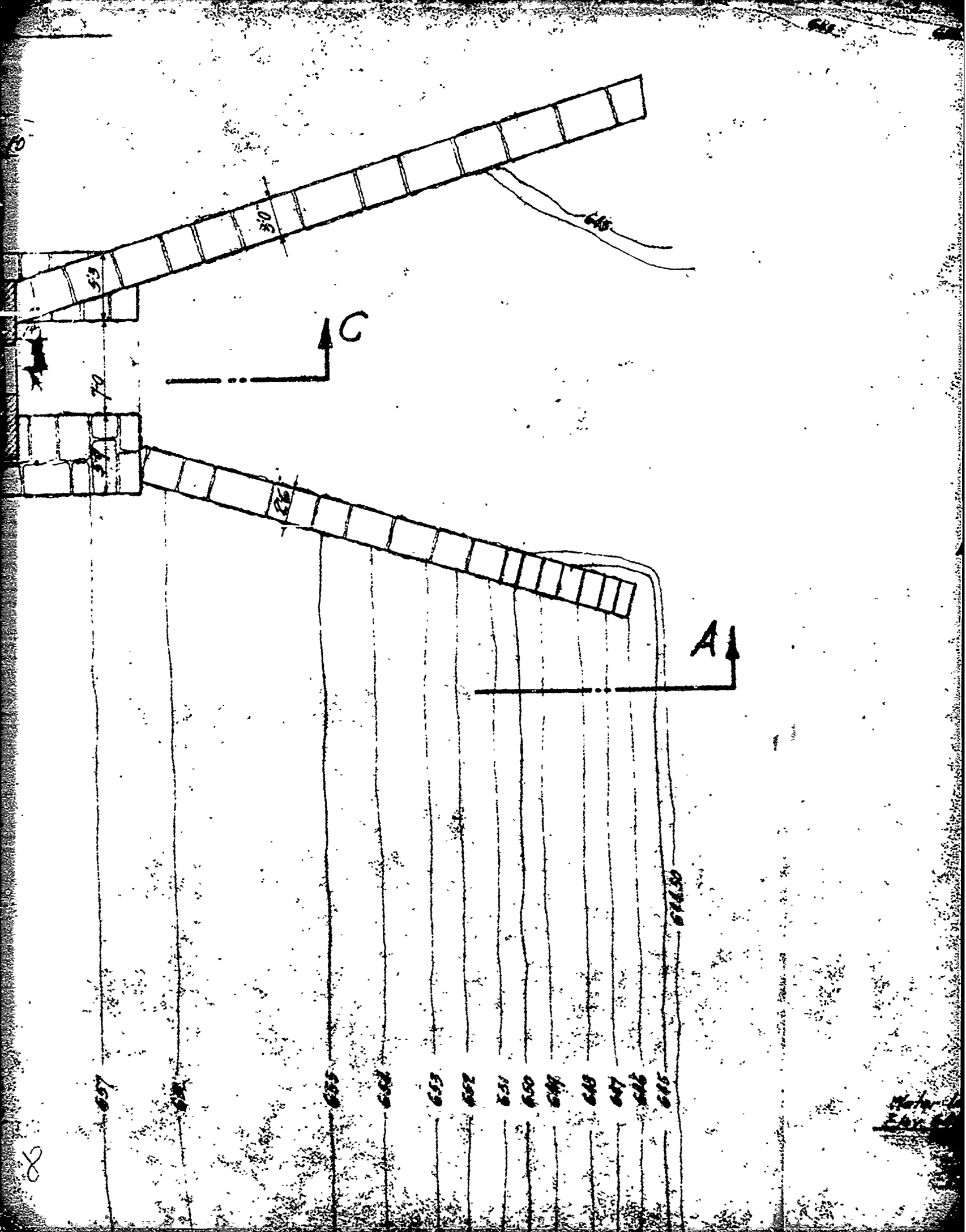
Scale: 1" = 100'

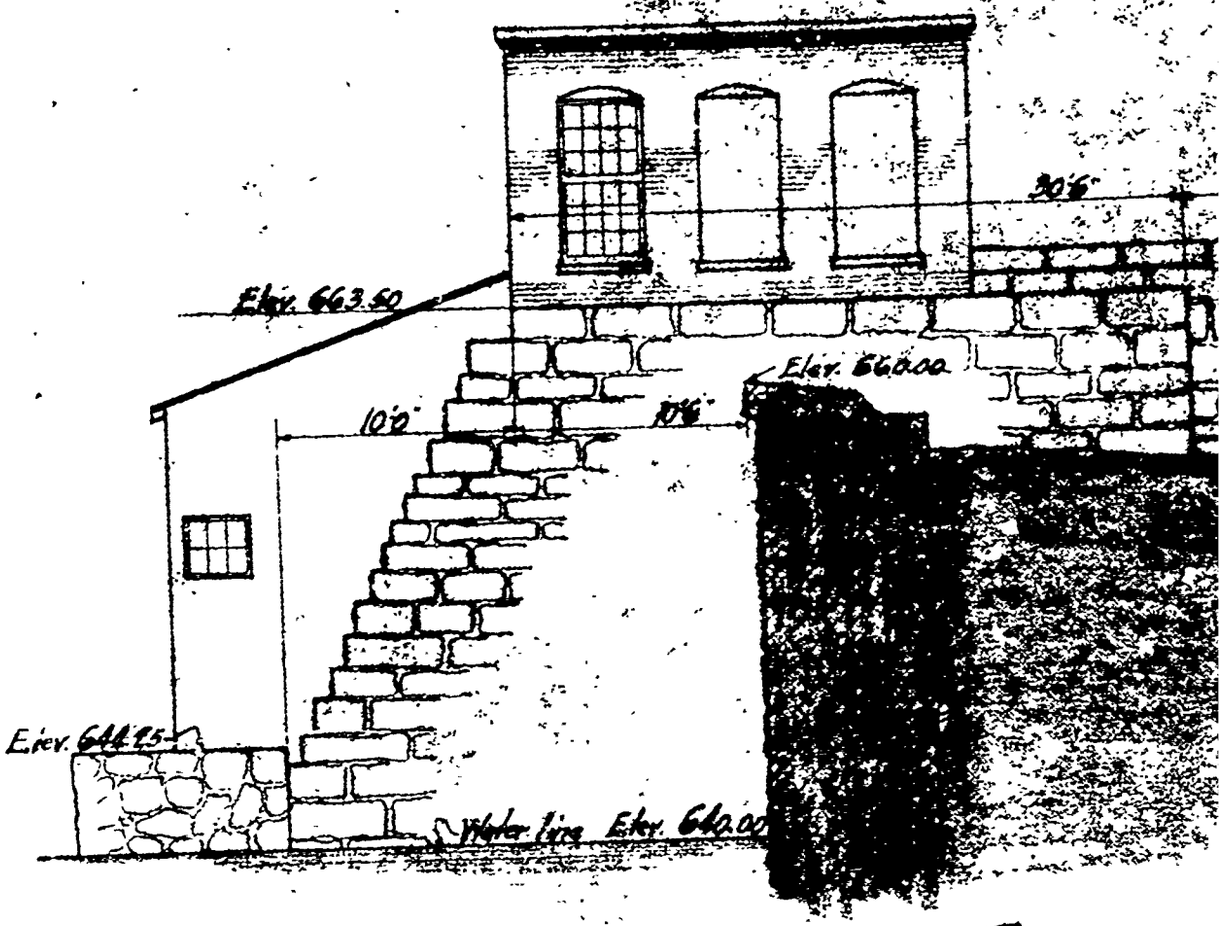

660
650
640
630
620



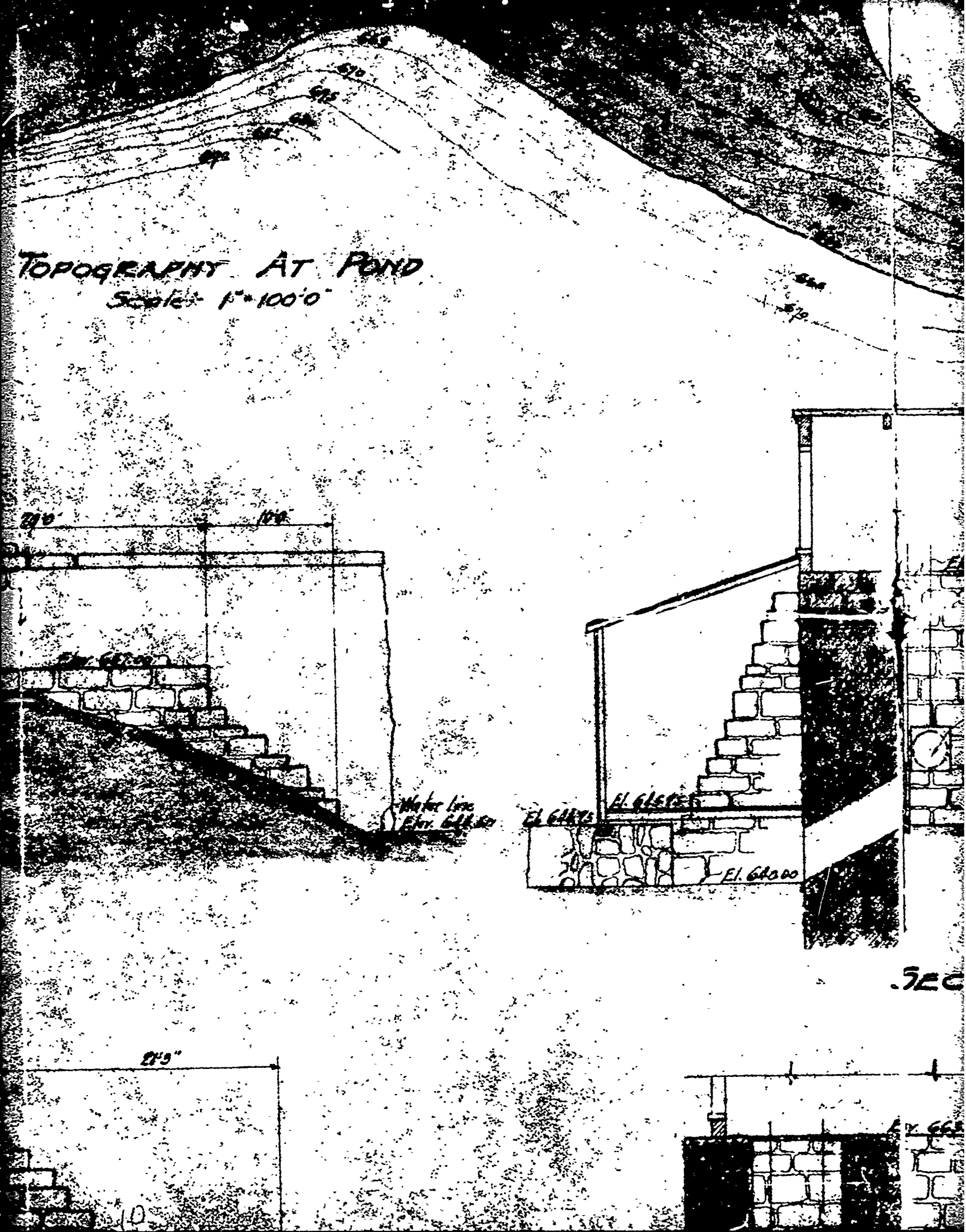


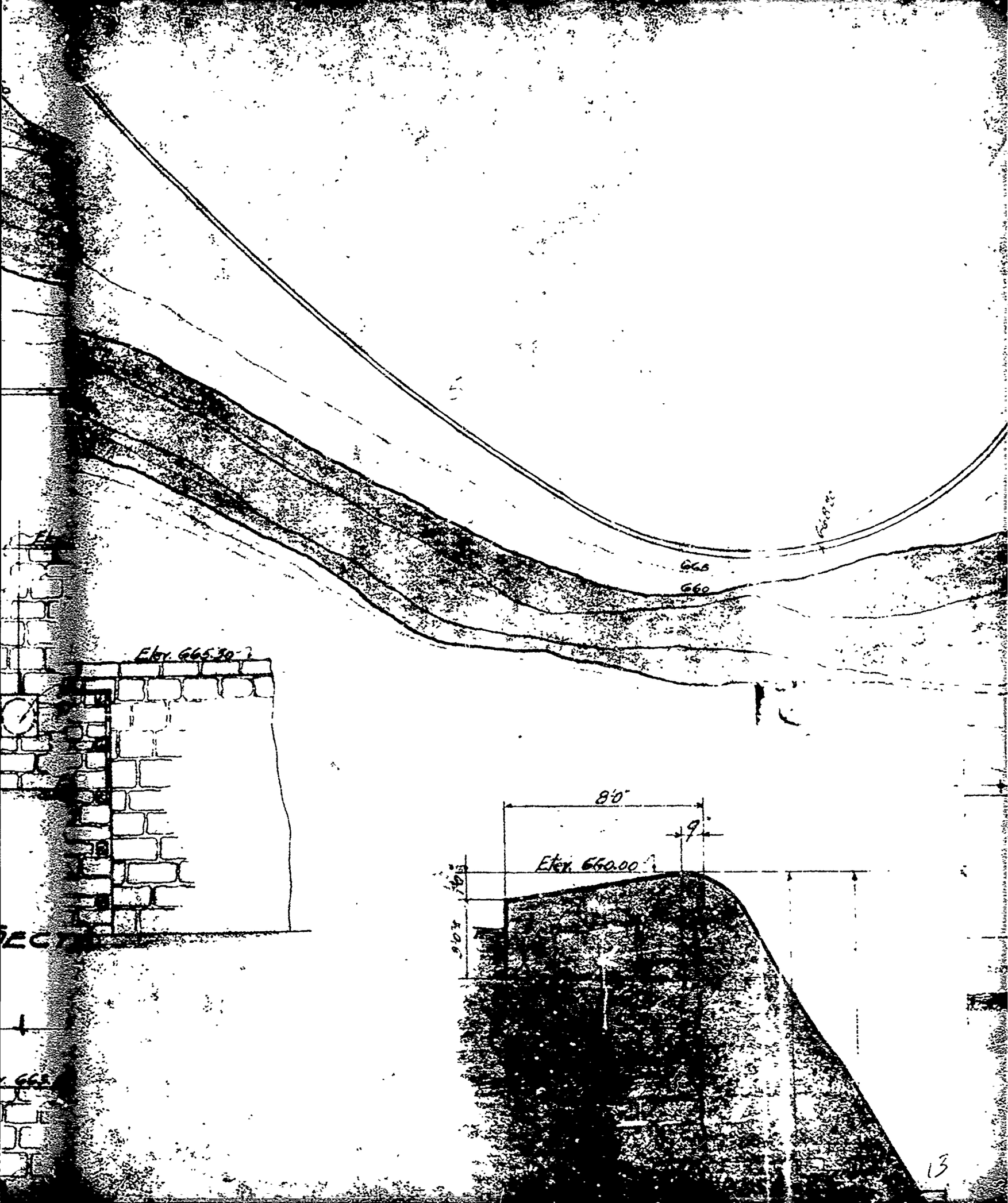
PLAN AT DAM

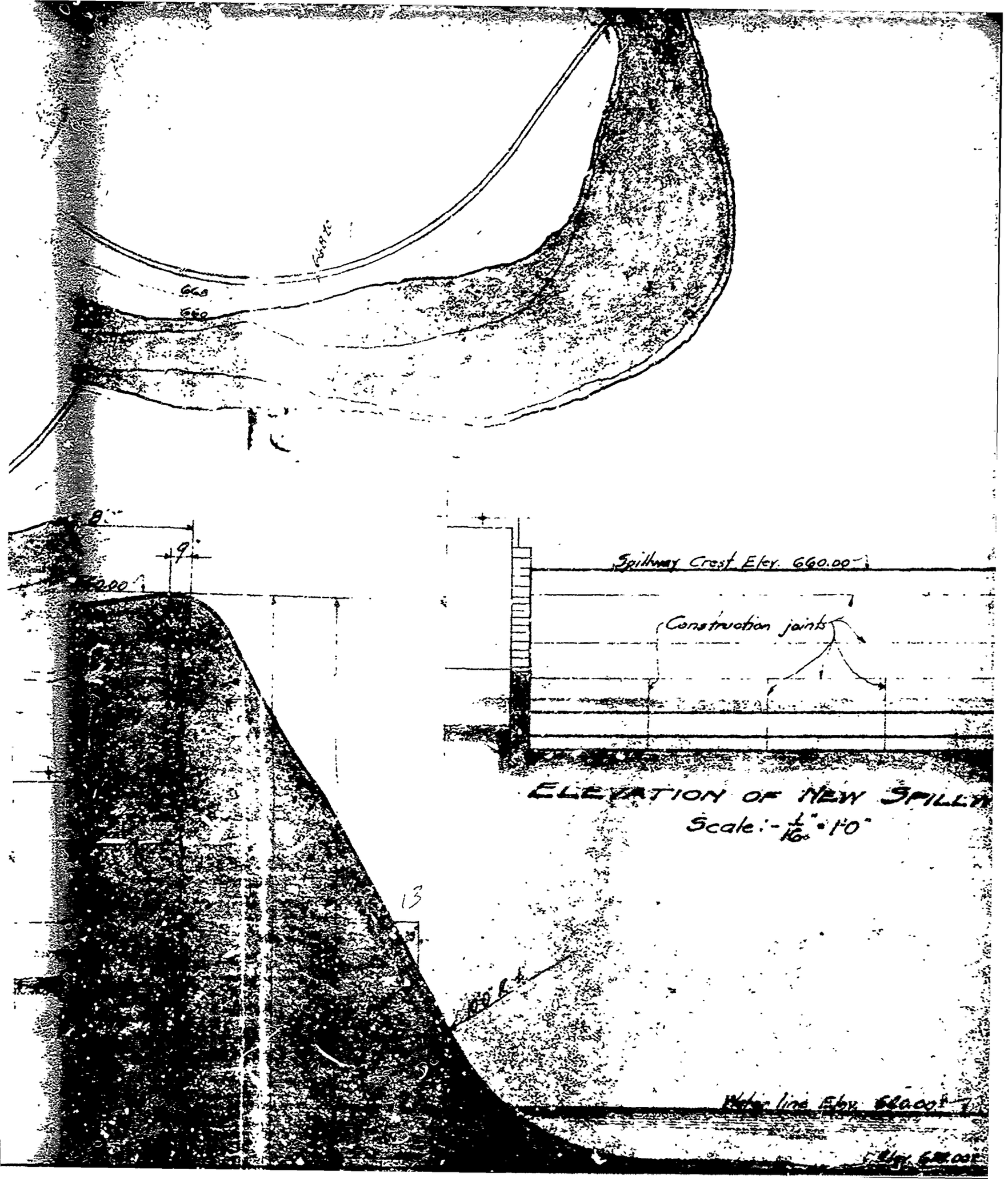

C
A


30'6"
Elev. 663.50
Elev. 660.00
10'0"
10'6"
Elev. 644.75
Water line Elev. 642.00

SECTION

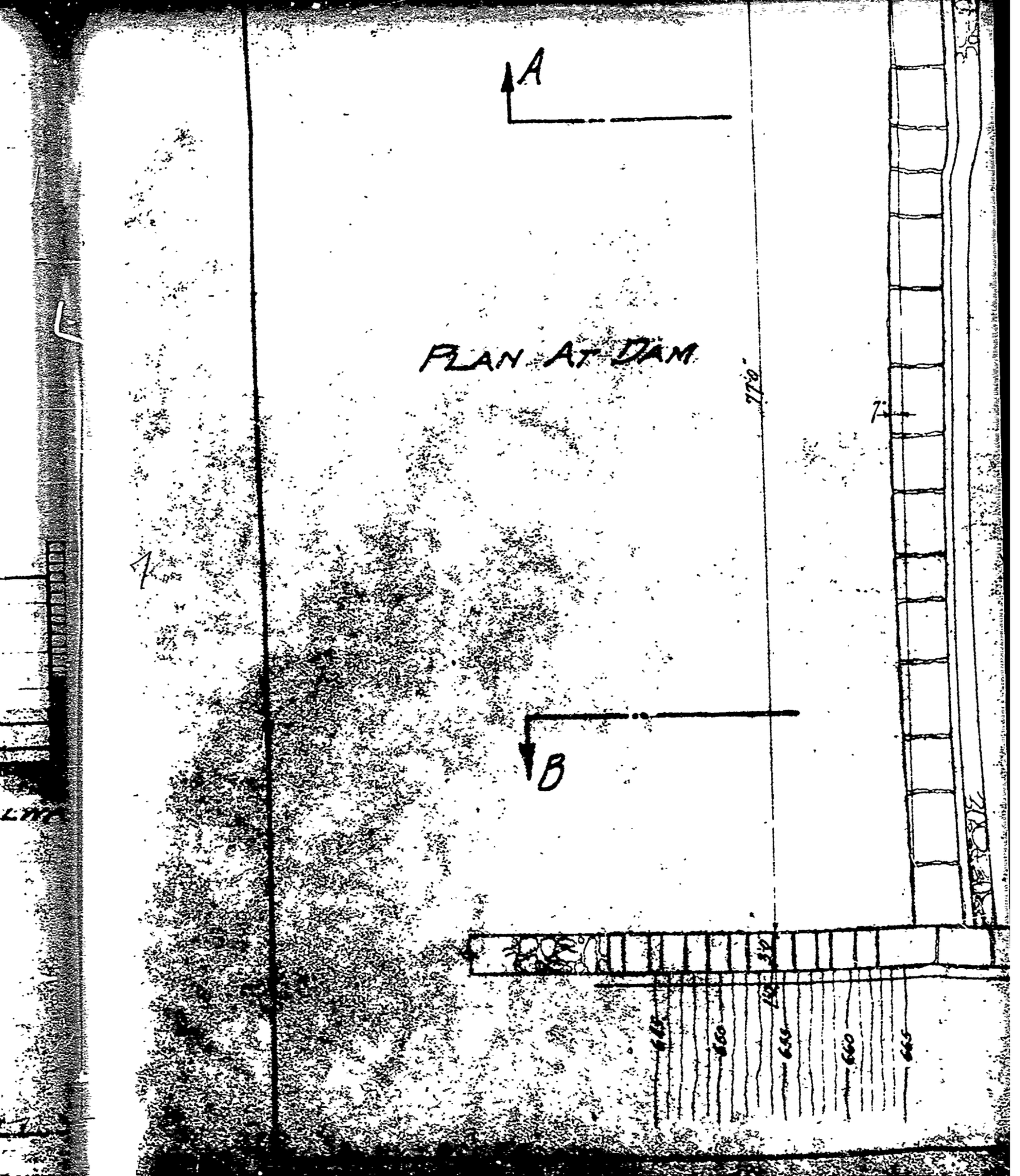

TOPOGRAPHY AT POND
Scale: 1" = 100'-0"
Water line
El. 644.50
El. 648.75
El. 646.25
El. 643.00
SEC

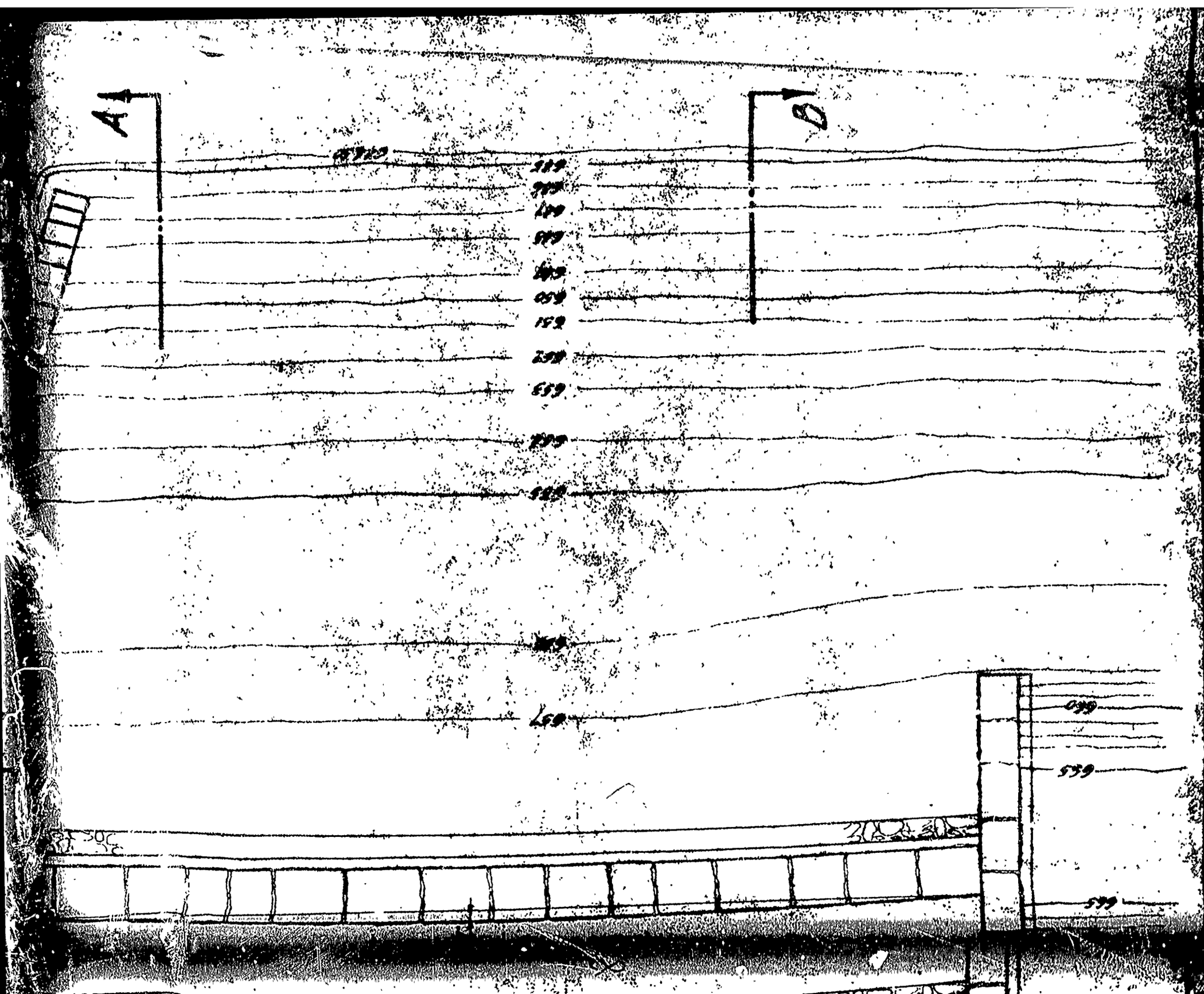

660
660
Elev. 665.30
8'0"
9"
Elev. 660.00

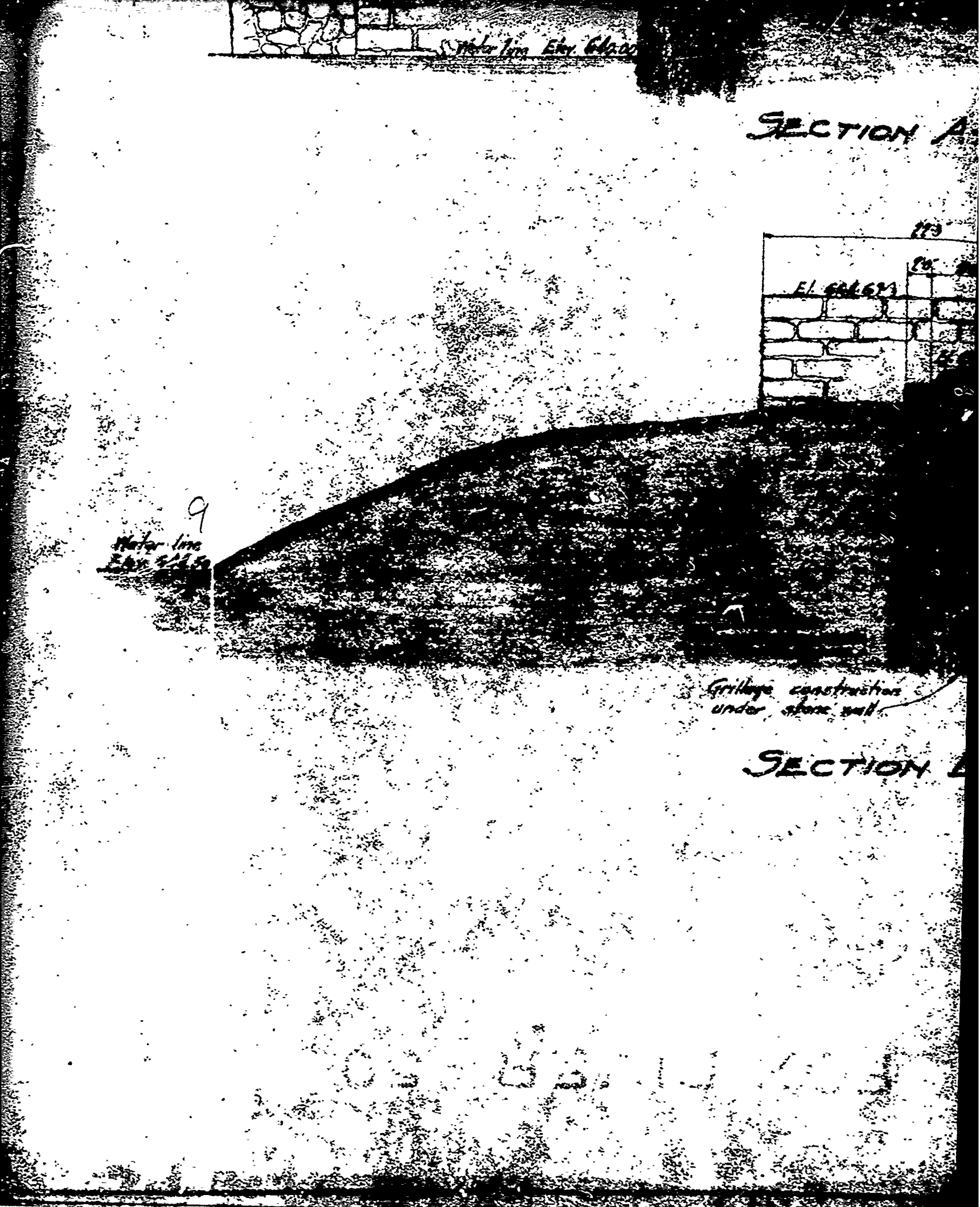


ELEVATION OF NEW SPILLW

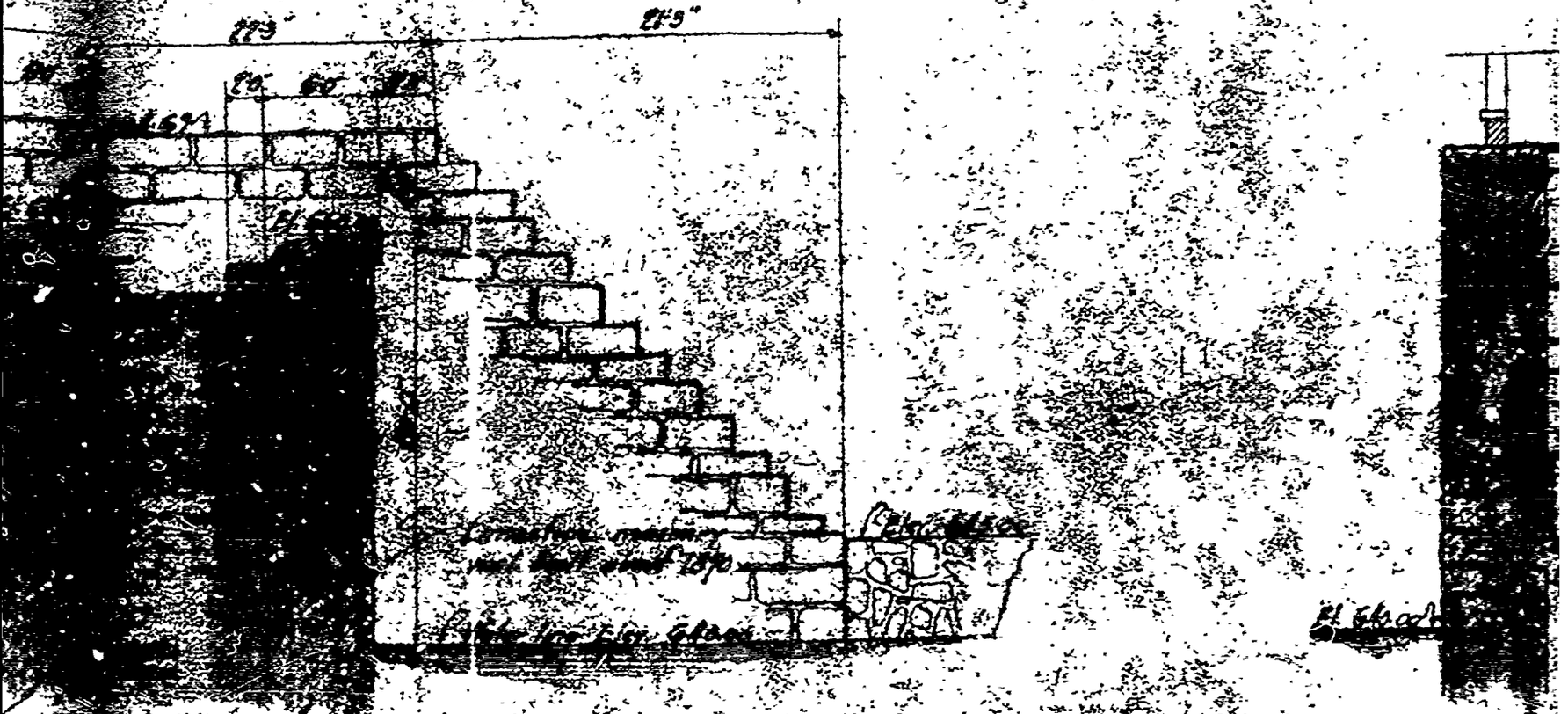
Scale:- 1/16" = 1'0"


A
PLAN AT DAM
B

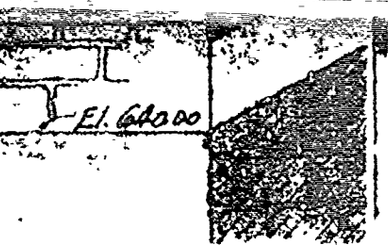

A1
D


Water line Elev. 64.00
SECTION A
El 66.62
9
Water line
Elev 64.50
Grillage construction
under stone wall
SECTION

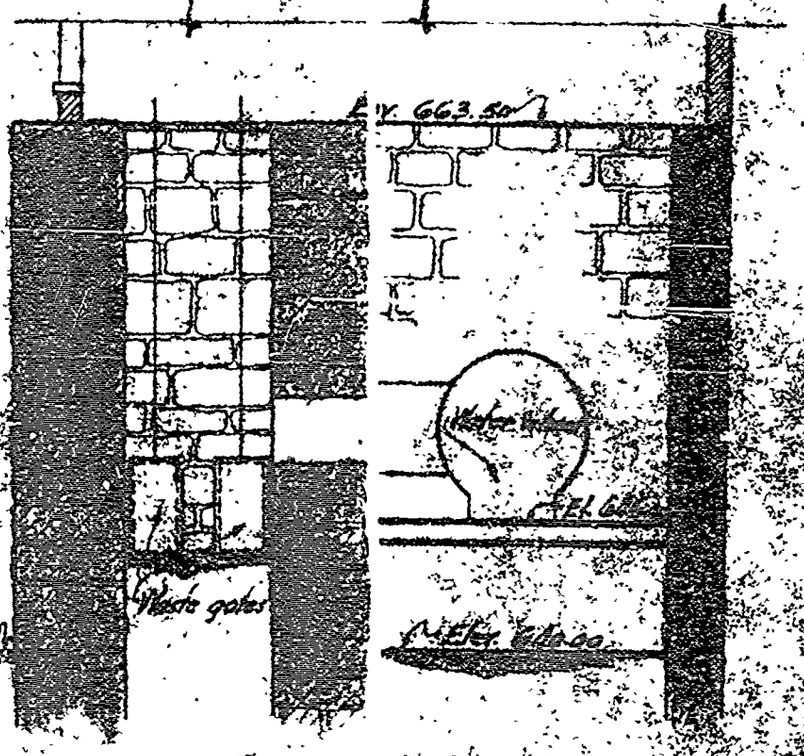
SECTION A-A



SECTION B-B



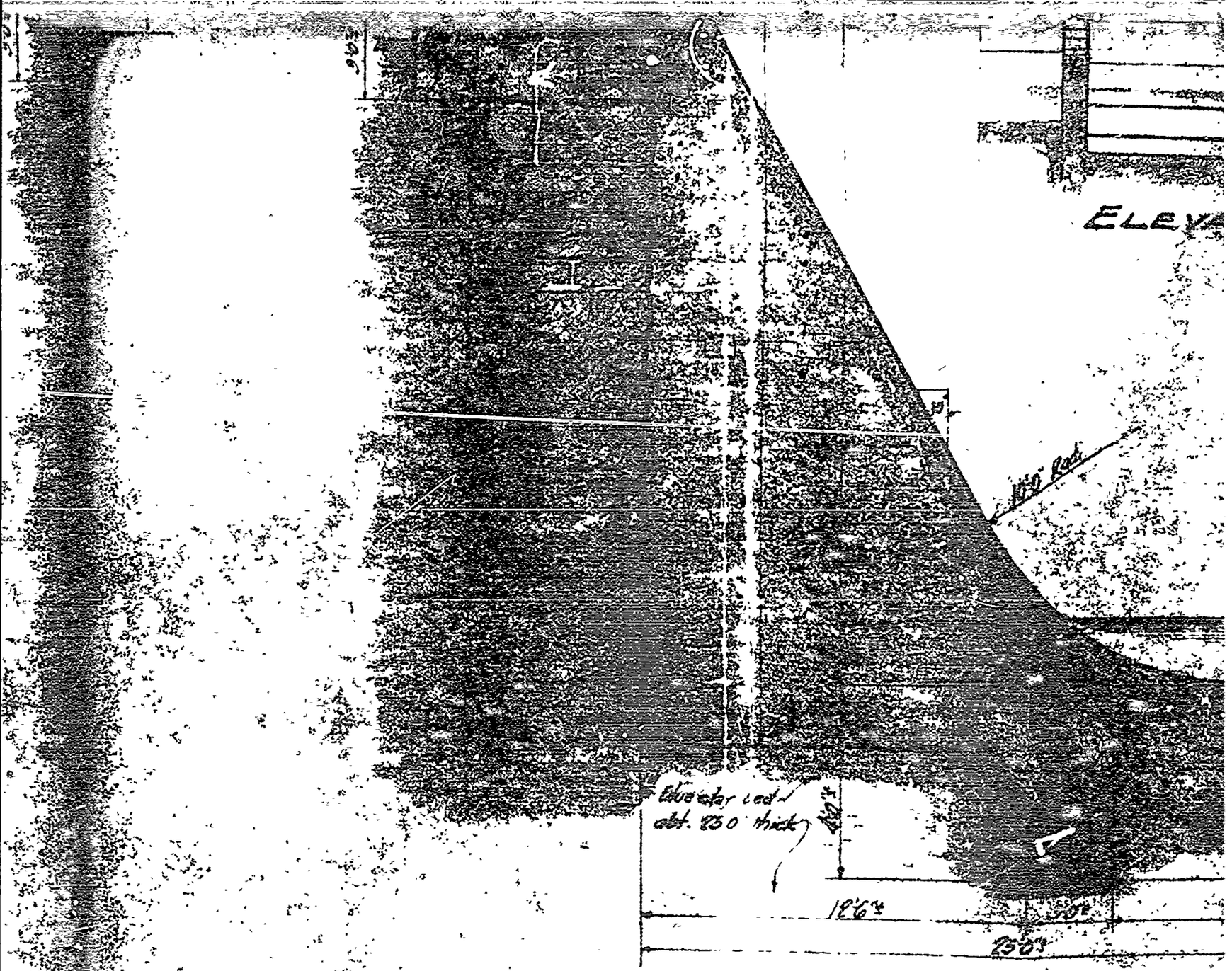
SECTION C-C



SECTION D-D

CONTRACTORS
J. J. TUCKER & SONS
AMSTERDAM, N.Y.

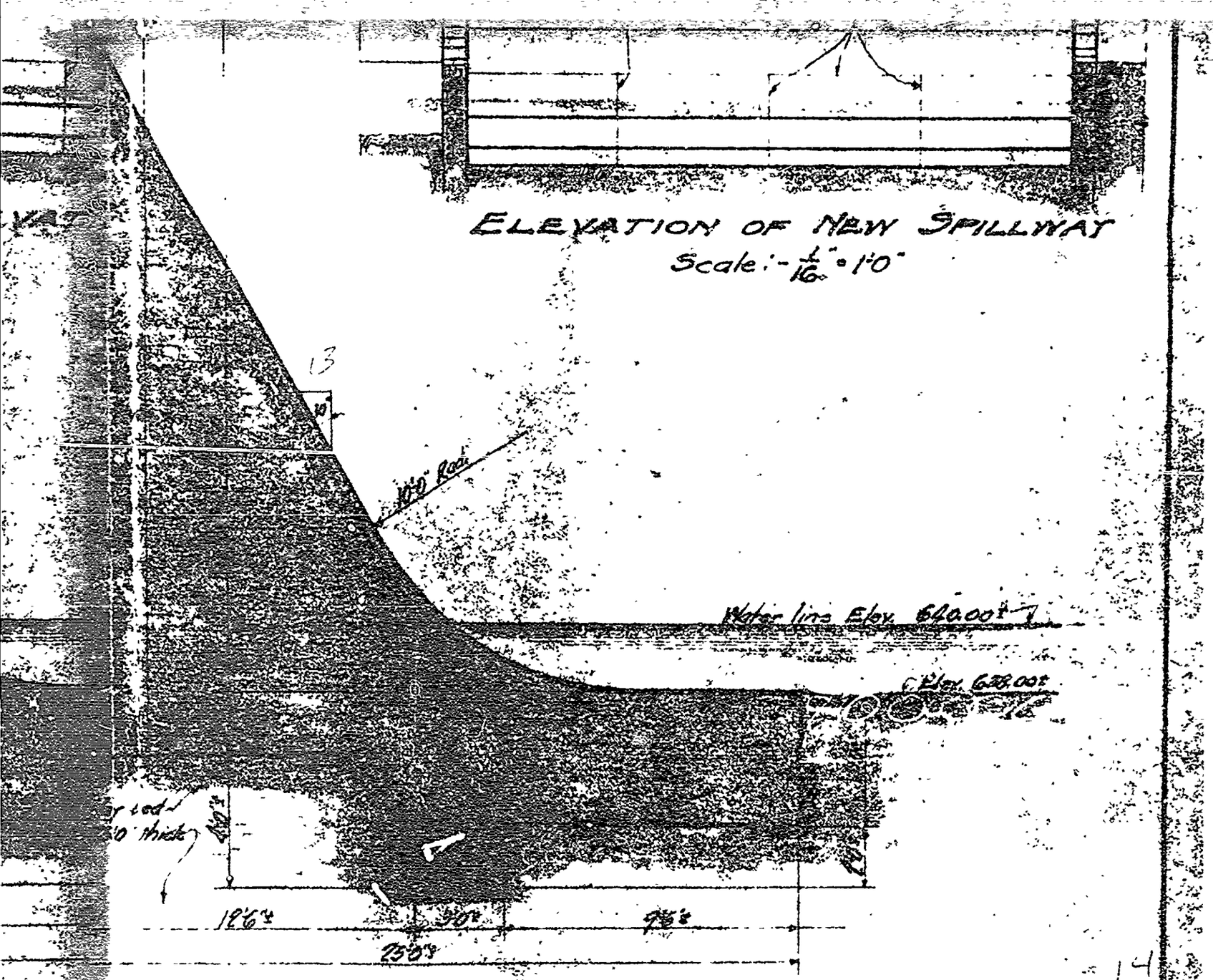
E
CHA.
AM



DAM CROSS SECTION SHOWING NEW CON
Scale:- ¼"-1'0"

ENGINEER
CHAS. W. BECKER
AMSTERDAM, N.Y.

NEW CONCR
ON
L.E. HAR
HAR
Scale:- ¼"-1'0"



ELEVATION OF NEW SPILLWAY
Scale:- 1/16" = 1'0"

CROSS SECTION SHOWING NEW CONCRETE SPILLWAY
Scale:- 1/4" = 1'0"

NEW CONCRETE SPILLWAY
ON DAM OF
L.E. HARROWER & SON
HARROWER, N.Y.

Scale:- 1/2" = 1'0"

MAY 12, 1931